ROADS AND STREETS

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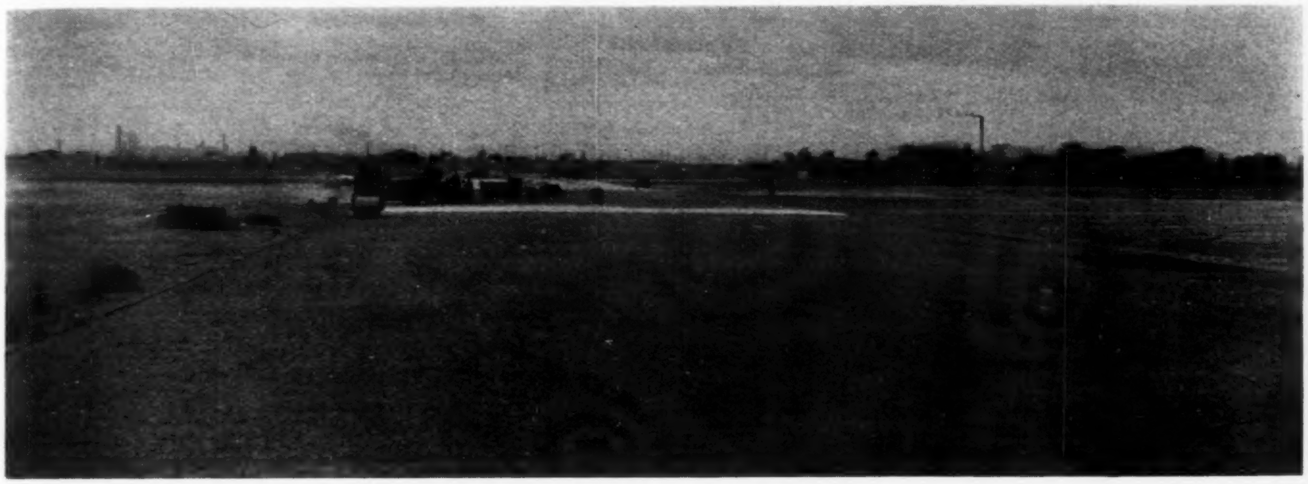

The Drainage, Grading and Surfacing of This Field Were Handled by the City's Paving Engineer

Airport Development and the Highway Engineer

The Drainage, Grading and Pavement Requirements at the Detroit City Airport

By PERRY A. FELLOWS
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A NEW form of transportation is demanding attention, and with it a new set of problems for the engineer. The task of arriving at the proper solution rests upon the fellow best equipped to assume that responsibility. This means that the trained and experienced engineer will work out a solution for the difficulties which the pilot has met. It does not mean that the pilot will establish himself as an airport engineer and offer his own solutions. If the pilot should be an engineer as well, then the happy combination will satisfy the first and only essential requirement.

The interest of the road engineer is a legitimate one. Many of the principles of traffic control which have been worked out in connection with the safe use of the highways are of value in solving the new problems. The construction and care of the airport and its runways calls on no other branch of the profession to the extent that it does on the highway engineer with his training in the study of grading, draining, surfacing, snow removal and maintenance.

In Detroit the responsibility for the development and operation of the airport has been assigned to the chief paving engineer of the city engineer's office, and in other instances similar procedure has been followed. The Wayne County airport is being developed by the road commission, under the immediate supervision of the engineer-manager. The state of Michigan has an advisory aeronautical board in liaison with the staff of the state highway commissioner.

Detroit City Airport.—During the past 18 months, the department of public works of Detroit, Mich., through the airport division of the city engineer's office and its construction division, has converted a rough, swampy river-bed into an airport. This river-bottom, 200 ft. wide, 20 ft. deep, its banks and borders covered with dense underbrush, and used as a rubbish dump, has been graded, provided with fences, turf, concrete and asphalt runways, fuel, hangar and other facilities. It affords excellent service for the hundreds of planes and thousands of pay-passengers that have taken advantage of the facilities offered since the beginning of practical operation in June, 1929.

The Detroit city airport is one of the outstanding examples of close-in location. It lies well within the city limits, five miles northeast of the city hall and 4½ miles due north from the river at Belle Isle Bridge. The Detroit Terminal Railroad is an industrial belt line and its right-of-way adjoins the southern edge of the airport for more than ½ mile.

The area of the field is now approximately 270 acres. Authorized additions will increase this to 300 acres in the near future. The land now owned by the city is in two strips separated by French Road. The plan to consolidate these parcels by vacating the street which lies between them has recently been approved by court decree.

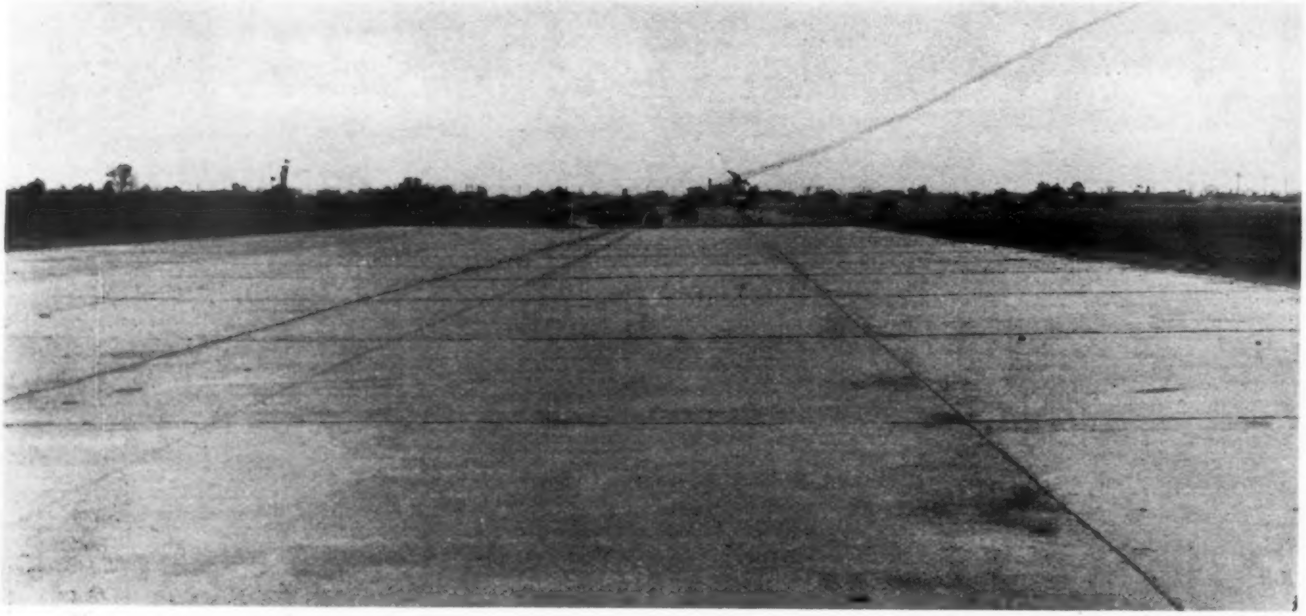
Drainage.—In general, the field at Detroit as finished is nearly flat and the elevation is 619 ft. above sea level.

In addition to the large trunk sewers which extend the length of the airport, and which form a part of the city sewer system there is a complete drainage layout consisting of laterals, drain tile and catch basins. This net-work is installed gridiron fashion over the field and is connected into the large Connors Creek sewer underlying the airport.

To adequately drain the 250 acres within the airport boundaries, required five miles of 12-in. to 18-in. lateral sewers and 17 miles of 4-in. and 6-in. drain tile in trenches backfilled with ½-in. stone. These trenches were for the most part in parallel lines 50 ft. apart.

The tile in these trenches was laid on a 1 per cent grade and the depth of the tile below the surface was from 3 to 4 ft.

The drainage system for a number of airports has been worked out on the



Each of the Two Main Runways Consists of Two 100-Ft. Wide Strips of Pavements 300 Ft. Apart on Centers

basis of soil characteristics very much as golf course drainage or farm drainage is designed.

The planning of such work on the basis of intensities of storms and time of run-off for maximum economy has been conspicuously lacking. The importance of this latter form of investigation should receive greater emphasis. In Detroit the great variety of filling materials that went into the preparation of the field tended to render the results of a soil survey less informative than is ordinarily the case. The plan to build ultimately a comparatively large area of hard surface runways and aprons made the soil characteristics and tile drainage of less significance than it might otherwise have been.

New Phases of Sewer Design for Airports.—A very excellent statement of some of the new phases of sewer design for airports is made by Mr. W. W. Horner in the "Engineering News Record," Nov. 7, 1929. Mr. Horner says:

"It was concluded that a proper policy would involve the taking off of a one-year-frequency rain very nearly as fast as it falls, and that it would be undesirable to have water remaining on the field surface longer than two hours.

"It was decided to design the drainage system on this basis, which was quite comparable to what would be used in a stormwater sewerage system, it being evident, of course, that any such system, if large enough to carry off rainfall as it fell, would be ample to serve also as main drainage or outlets for a system of tile drains.

"We could find no record of any scheme of design covering the conditions outlined and were finally forced to make an extended research on a mass-time basis of the movement of water from a rainfall of this character. This work was carried out by E. E. Bloss and Clarence Miller, civil engineers of the department, in rather careful detail for a typical 30-acre unit. It involved studies of the effect of storms of different intensities and durations in flowing through a provisionally determined system. The study required computations, at 10-minute intervals during such a storm, that would show instantaneous rates of discharge and total discharge as compared with the amount of rain falling, the amount of water in surface film, the amount in storage in porous rock backfill and the amount in transit in drains. For this typical unit, a rain of about 45 minutes' duration seemed to give the most severe load, and a proper handling of the water with all allowances for storage and water in transit required a discharge capacity for the mains of about 0.42 cu. ft. per second per acre, or about 30 per cent of the rainfall rate.

"On account of the great amount of detailed computation required, it was not considered practicable to go through such a study for each piece of design. Accordingly this rate of runoff was used for all similar areas and was modified somewhat for areas of other size and time characteristics.

"The continuing development of a general field plan during and after the drainage work had been started has produced several conditions at variance with the original assumption as to type of surface, and further changes still possible indicate the futility of any application of extremely accurate methods to the design of this particular drainage system. However, in view of the immense amount of work of this character to be done throughout the country and the indications that a standard plan for airports will have been developed within the next year or two, it would seem highly desirable to continue research studies of this kind under more normal conditions where the engineer is not faced with the necessity for immediate construction. It would not be difficult to bring together pertinent information and to plan a scheme of application of these data to a rational design so that a sound engineering technique might come into being."

The limited experience with the completed drains in the Detroit city airport indicates that they are satisfactory. The installation at St. Louis, made as the results of the studies by Mr. Horner, are comparable to the Detroit practice.

Preparation of the Surface.—Work at the Detroit city airport has progressed on the full length of both sections of the field. The filling of the creek bed which traverses the field has been done during the past two years by opening it as a dump for excavated material from city paving operations, sewer tunnels, excavations for building foundations and to a limited extent for a rubbish dump. Over 1,000,000 yd. of fill were needed to bring the old gully up to the level of the landing areas. Other work incidental to the preliminary preparation of the field included the removal of buildings, trees and brush, fences, old subdivision sidewalks, telephone and electric light poles and other things within the limits of the field. In the westerly portion of the field, a $200,000 garage and repair shop belonging to the water bureau of the fire department was vacated by them in June, 1928, and the building razed. The salvaged materials were used so far as possible in the reconstruction

of the building on another site on the west side of the city.

Grading operations have been carried on with a view to having a smooth surface with no slope more than 2 per cent in any direction. The fills in some instances have exceeded 30 ft. and allowance for shrinkage was necessary. A finish layer of top soil has been placed to make it possible to grow a sod on the field.

The areas which have been brought to grade and harrowed, fine graded, seeded and rolled. Various seeds were used, some bluegrass and special mixtures. Vetch was sown in poor soil and some rye was used to protect the younger plants where needed.

Surfacing the Runways.—There is no general agreement in the practice of surfacing the runways; in some of the discussions it would seem as though it must be a definite choice between hard surface runways or a sod surface over all. We do not agree with this limiting choice but believe that the two types can be combined to good advantage.

The design and construction of runways is the feature of airport engineering that falls to the lot of the highway engineer. Only by means of a long smooth surface are airplanes enabled to take-off and land at the prevailing high speeds. Not only is this a present condition, but if the airplane continues to develop along existing lines, they will require long runways for some time to come. More reliable construction of planes has enabled designers to decrease wing area, thus securing greater velocities, but at the same time requiring higher take-off and landing speeds. Accordingly, average landing speeds have increased rather than decreased in recent years, and not even the most optimistic or radical of engineers can build an airport solely for helicopters. Only two or three years ago a landing speed of 50 miles per hour was common in commercial work, whereas 60 miles per hour is quite normal today. An airport designed to occupy a permanent place in national aviation must possess runways that are safe and convenient under all conditions.

Sufficient length to allow the plane to stop after a poor landing is therefore the most obvious requisite of a landing field. A hard surface with satisfactory degree of smoothness is equally important, because if the wheels are unduly retarded, the plane tends to revolve about them, and when the overturning moment becomes greater than the resisting moment, the result is unfortunate. A strong wind across the runway tends to whip the plane off its course, and so it is important that the plane head into the wind when landing, necessitating runways in more than one direction.

Runways at Detroit Airport.—The Detroit city airport has two main runways about 80 deg. apart, and intersecting at their lower ends. Each runway is to consist of two 100-ft. wide pavements, 300 ft. apart on centers. One runway bears N. 35° 39′ West and the other S. 63° 47′ West. The north-south runway has a length of 4,900 ft. and the east-west runway a length of 4,150 ft. The prevailing winds closely parallel the latter approach. A taxi strip near their intersection connects the runways with the concrete apron fronting the hangars.

Another runway crossing both of these near their intersection has been provided.

Thus far, to accommodate planes landing and taking off, 3,450 lin. ft. of concrete runways were built at a cost of $87,295; 7,900 lin. ft. of asphaltic runways at a cost of $148,452.58. All runways are 100 ft. wide and completely drained. In addition, approximately 1,800 lin. ft. of concrete aprons were constructed at hangar approaches. These aggregate over 25,000 sq. yd. of surface were constructed, varying in width from 100 to 150 ft.

The use of hard-surfaced runways will undoubtedly increase at airports where a schedule of flights must be maintained in all kinds of weather. At the Detroit airport such pavements are especially needed because of clay forming a large part of the soil, which cannot be expected to drain quickly in wet weather, despite the system of drain tile now being installed. It is planned to provide more runways when the additional area is annexed to the airport.

Three types of pavement have been used to surface the runways:—1-course plain concrete, sheet asphalt on water-bound macadam base and 2-course bituminous concrete. The 100-ft. width of the 1-course is laid in eight strips with a longitudinal joint between the two central strips. Transverse expansion joints filled with pre-molded mastic are placed every 30 ft. They are edged to a ½-in. radius. The thickness of the slab is 7 in.

The Concrete Pavement.—The specifications for the concrete are the outgrowth of long experience with 1-course streets and alleys in Detroit. A field mix of 1:2:3 is specified, with

Over $282,000 Has Been Expended for Paving Runways and Hangar Approaches to the Detroit Airport

either pebbles or crushed stone permitted for the coarse aggregate. The grading of the sand is fully detailed and its fineness modulus must be between 2.60 and 3.60. Pebbles have a fineness modulus between 7.00 and 7.80, and range in size from 2 in. to ¼ in. Crushed stone is also graded for 2 in. down and must meet specified tests for hardness, toughness and wearing quality. As in other city paving, water content is indirectly controlled through the consistency of the mix. A maximum slump of 3 in. is permitted, and to minimize variation it is specified that the mixer must have a water measuring tank with a visible gauge. The time of mix is one minute.

Adequate curing of the concrete is secured by keeping it wet for seven days. Because it is recognized that plastic concrete contains more than enough water for complete hydration if evaporation is prevented, curing by silicate of soda has been permitted in the sections so far constructed. In this case the slab is covered with burlap as soon as it is finished and kept wet until hard enough to permit the application of the sodium silicate.

The obligation of the contractor to produce concrete meeting definite strength requirements is checked by test results. Cylinders made from the concrete going into the pavement must develop a strength of 2,500 lb. at the age of 28 days. Slab thickness as well as strength is determined by cores drilled from the completed pavement. These cores must show a compressive strength of 2,500 lb. at 28 days, 3,200 lb. at 90 days and 4,000 lb. at one year.

Two sections of concrete runway under contract have been completed. Cores taken from these sections and tested at 28 days averaged 3,992 lb. per square inch. The individual core tests ranged as follows:

	5,360		2,495
	4,520		3,900
	4,370		3,310
Average	4,750	Average	3,235

The cylinders made from the concrete showed an average strength of 3,362 lb. Three cores taken from the concrete apron broke under the following unit loads:

	2,860
	3 800
	3,560
Average	3,470

The corresponding apron cylinders average 2,779 lb. per square inch.

Bituminous Concrete Pavement.—The bituminous concrete, or black base pavement, is more of an innovation in this city than the other type, but is the belief of the engineers that it will be satisfactory for the kind of traffic for which it is designed. The fact that there is a large city-owned asphalt plant on the airport property made this kind of construction especially feasible. It consists of 2 in. of sheet asphalt over 5 in. of asphaltic concrete. The width is 100 ft. and the cross-section shows a 6-in. crown at the center. A line of porous 6-in. tile in a gravel filled trench is laid under each edge and the center line.

The asphaltic concrete base is a mixture of asphaltic cement with coarse and fine aggregates conforming to the following composition limits by weight:

	Per cent
Passing 2½-in. screen, retained on 1¼-in.	15 to 45
Passing 1¼-in. screen, retained on ¼-in.	15 to 45
Passing ¼-in. screen	25 to 40
Bitumen (asphalt cement soluble in carbon disulphide)	4 to 7

This mixture is delivered at a temperature of 225° F. to 325° F. and laid on a dry sub-grade. It is laid on two layers so that it can be more completely compacted.

Part of the section of black base now being constructed lies over a filled-in water hole. The pressure of the roller served to bring water to the surface by an artesian well effect, producing muddy spots on the surface of the base. Spreading hay over the sub-grade prevented recurrence of this trouble.

There are now three completed sections of the black base, one built by the Department of Public Works, and two by private contractors. This work has been tested for depth by coring, and has averaged over the requirement.

The surface course consists of asphaltic cement, sand and mineral dust, mixed to produce the following composition:

	Per cent
Bitumen	6 to 75
Mineral matter passing 200 mesh screen	6 to 8
Mineral matter passing 80 mesh screen	8 to 10
Mineral matter passing 40 mesh screen	12 to 15
Mineral matter passing 10 mesh screen	8 to 10
Mineral matter passing ¾ mesh screen	45 to 55

The asphalt mixtures for the sections constructed by the department of public works were prepared at the neighboring municipal asphalt plant on French Road.

One section of runway 500 ft. long was built during the winter when it was planned to hold the All-American Aircraft Show at the City Airport. Because of the fact that the ground was frozen, it was necessary to resort to blasting to prepare the grade. This section was built as a 3-in. sheet asphalt top on a 12-in. water-bound macadam base. The cost was not segregated from other work done at the same time, but is estimated at $3.00 per square yard because of the unusual conditions under which the work was done.

In addition to this, there are 45,373 sq. yd. of 1-course concrete 7 in. thick built or under contract, at an average cost of $1.93 and 81,574 sq. yd. of 2-in. asphalt on 5-in. black base at an average cost of $1.59 per square yard. The totals for hard surface completed are 164,093 sq. yd. for a cost of $282,811.31. Plans are being prepared for additional strips.

Runways and Airfield Requirements.—In a paper presented at the Eighth Annual Asphalt Paving Conference, West Baden Springs, Ind., Mr. R. H. Simpson said a prominent government official is quoted as saying recently that "the crying need of aviation today in the United States is one hundred properly equipped airports located at strategic points. There is no doubt of such need. But I would go further and say that the greatest need of air transportation today is paved take-off and landing areas at our airports. We must equip our airports so that they can be used twenty-four hours in the day and 365 days in the year. With transport ships flying on schedule and more such scheduled air lines being established monthly, we have reached a point where the delay to the departure of ships, or the inability to land because of a muddy field, is intolerable.

"It is recognized that in some parts of the United States, such as the arid sections of the west with sandy soil, paved runways may never be required. An oil treatment will give a firm and dustless surface. There are also locations underlaid with gravel, that, no doubt, can be treated with asphaltic oils at nominal expense and produce a satisfactory surface. But the greater percentage of airport sites will require paved runways if dusty and muddy fields are to be avoided. I believe that the condition of the runways is now a deciding factor in determining the suitability of a field for the safe operation of a given plane."

Mr. Simpson presents eleven requirements:

1. It should be one that can be built at reasonable cost.
2. It should have a well drained sub-base.
3. It should have a base to distribute the load.
4. It should have no abrupt change in grade.
5. It should have an even, true surface.
6. It should have a roughened or non-skid surface texture.
7. It should have a waterproof surface.
8. It should have a slope to carry off water.
9. It should have a dustless surface.
10. It should have good visibility from the air.
11. It should have a surface easily and quickly repaired.

The relative importance of these and other possible characteristics will vary for different airports. The task of weighing the requirements and designing the structure to satisfy the demands should be left in the hands of competent engineers.

Acknowledgment.—The foregoing is an abstract of a paper presented at the 16th Purdue Road School.

Measures for Relief of Traffic Congestion

Summary of Report of Committee Presented at Recent Meeting of National Conference on Street and Highway Safety

ECONOMIC and financial loss to the American people from traffic congestion on the streets and highways is involving the tremendous sum of more than $2,000,000,000 a year, apart from costs and waste from traffic accidents and mishaps, according to the findings of the Committee on Measures for the Relief of Traffic Congestion of the National Conference on Street and Highway Safety. The report of the committee, signed by E. J. Mehren, of Chicago, as chairman, was submitted to the third National Conference on Street and Highway Safety, which was held in Washington on May 27, 28 and 29.

Traffic Congestion Not Necessary Evil.—At the outset of the report, the committee says that traffic congestion is not a necessary evil. It urges the Federal government, and the towns and cities, to take a forward step to relieve congestion by giving consideration to the need of adequate street service adjacent when planning and constructing public buildings.

The committee states:

"Traffic congestion is not a necessary evil. It can be alleviated and to a very large degree eliminated by careful study and judicious expenditure for immediate relief measures and permanent improvements, and by the sound control of land use.

"All cities should look forward to their future needs and plan now for coming requirements for adequate handling of the traffic problem.

"As an important contribution to this end, the committee considers that federal, state and municipal governments should give prompt consideration to the problems of traffic congestion that will arise through the erection of new buildings for governmental use.

"Plans for the location and construction of such structures should recognize the need for adequate street service adjacent to these areas, easy access to the buildings, requirements of employes for off-street parking, congestion, and the needs of the general area in relation to such buildings or groups of buildings."

In defining the elements and causes of traffic congestion, the committee also mentions as outstanding the growth in population, increase in the number and use of motor vehicles, and the more intensive use and employment of land.

These elements, says the committee, create congestion, however, only by reason of the two fundamental causes of inadequate streets and roads, and the inefficient and conflicting use of them.

Relief Measures Suggested.—Outstanding among the findings and remedies proposed by the committee are the following:

In view of the improvement in traffic conditions that can often be effected by relatively small cost in comparison with the benefits, there should be increased expenditures in most communities for the relief of congestion.

Such expenditures can be made most effectively in accordance with a comprehensive plan developed by competent technical study.

Each municipality with a traffic problem should have a traffic commission of citizen and official members.

Except on a few major thoroughfares connecting large centers, and at a few major intersections, there is normally no serious congestion on rural highways outside of metropolitan areas.

Immediate relief measures to be effective must cover adequate control of traffic at important intersections, standard rules governing turns, marking of traffic lanes, parking regulations, restructions on the loading and unloading of fuel, building materials, and similar supplies, separation of traffic by allocation, protection and expendition of pedestrian movement, and vigorous enforcement of regulations.

Permanent relief measures must include creation of major thoroughfares in accordance with traffic flow needs, improvement of intersections, elimination of grade crossings with high frequency of vehicle or train movement, widening of roadways, street extensions and connections, parallel routes, new arterial highways, development of bypass routes, construction of parkways, development of off-street parking and loading, and provision for playgrounds for children.

Results of Lack of Planning.—The committee points out with emphasis that the inadequacy of streets and highways, springing from the lack of far-sighted planning and zoning, has resulted in choking many available thoroughfares. The mass movement of vehicles—street cars, buses, private and commercial automobiles, and parked cars—and pedestrians are all factors that are contributing to the congestion problem.

Inadequate planning and location of streets has had the effect of indiscriminate mingling of all types of traffic, with consequent congestion and confusion, which in the last analysis, the committee regards as an inefficient and improper use of available facilities.

Aggressive Leadership Needed.—The committee says further:

"Aggressive and intelligent leadership is the first requisite in the execution of measures for the relief of traffic congestion, whether in cities or regional areas. This leadership should be assumed by the mayor, city manager or other head of the city administration. To be effective it must be accompanied by the definite placing of responsibility, adequate technical guidance and public support.

"The formulation of traffic improvement programs and their execution touch upon the functions of many city departments, and in many cities the responsibility is divided. Coordination should be secured by the creation of an official traffic commission, which is considered desirable in most cities in excess of 25,000 population.

"In smaller communities the cooperation of existing local departments under the direction of the mayor or city manager or official designated by him will generally be sufficient.

"The membership of such a commission should include the heads of departments involved, with the addition of a member of the city council."

Adequate Traffic Flow.—Traffic congestion, says the committee, implies an uncomfortable over-crowding of street facilities. The friction that comes from it results in reducing the permissible speed of vehicles and pedestrians below that to which they feel they are entitled. The committee adds:

"There is not complete agreement as to what constitutes an acceptable rate of traffic flow consistent with the demands of safety and an equitable consideration of the rights of others. There is evidence, however, of a growing impatience with the rate of travel in metropolitan areas and an insistance for average speeds that approach those possible on the highways in less populated districts.

"In view of the more restricted operating conditions on city streets, and the greater degree of driving caution that is required, there must be a realization that except where congestion exists, speeds on the city streets are, in the main, high enough, and cannot and should not be increased except on streets designated for high speed traffic."

Maximum Street Capacity Not Used Efficiently.—Serious and aggravated wastage of time, says the committee, is found in section of the overcrowded metropolitan areas of the country during periods of heavy traffic concentration. The committee finds that this condition is evidence that the available street space is not being used in an efficient and organized fashion. The maximum capacity of the street system has been reached in only a few areas, and where congestion is not the result of some inherent defect in the street system, the application of recognized principles of traffic planning may be expected to bring results and improve-

ment well in excess of the cost. The committee adds:

"Traffic congestion is not a hopeless problem, and by proper study and judicious expenditure of funds, can be materially alleviated."

Where Traffic Congestion is Found.—In discussing the areas and points in cities and towns, as well as rural areas, where congestion is most usually found, the committee asserts that every residential, retail business and manufacturing district has its own peculiar street problems. As the volume of each kind of traffic increases, the problem becomes more complicated, with the result that a condition of congestion arises.

Congestion in the rural districts, however, has not become so serious a matter, the committee finds, as in the towns and cities except at or near gateways, and on a few large major highways connecting large centers of population.

Turning to the smaller towns, the committee says:

"Within the smaller cities and villages these conditions may or may not at present be acute, but regardless of the present degree of congestion, these municipalities will be remiss in their duty to the public if they fail to provide adequately for the present and future needs of both local and through traffic."

Intersections of streets or highways are found by the committee to almost invariably be points of greatest congestion, and requiring expert attention on the part of the public authorities to effect practical and economical relief.

Traffic Control at Intersections.—Since the intersections are the limiting points in the capacity of the street system, one of the first measures of immediate relief to be considered, when congestion becomes prevalent, is the control of traffic at intersections by some form of signal system. Traffic control alone cannot completely eliminate interference at intersections, but improvement can be obtained through careful and scientific control methods.

Traffic control lights are serving their purpose well, the committee finds, but when indiscriminately used, or too frequently placed, may become a nuisance, a menace to safety, and a contributing factor in the congestion problem. The committee says:

"Stopping for traffic lights where a light is unnecessary or improperly timed irritates the motorist and encourages contempt for traffic control and regulation.

"The utility of the traffic signal system depends upon the accuracy with which its indications are adjusted for traffic requirements. Signal timing and use must be changed from time to time to meet changing traffic conditions."

Traffic Lanes and Parking.—The committee strongly recommends the marking of traffic lanes on densely traveled main roads, particularly at the approach to intersections.

Parking as a factor in congestion is dealt with at length by the committee, and is pointed out as one of the serious and growing phases of the problem. The committee asserts that terminal facilities for vehicles, especially in central business districts, are essential to the transaction of business. At the same time, it is pointed out that parking on the streets is an uneconomic practice, with the costs from congestion frequently exceeding the benefits that come from it.

As one means of relief, the committee suggests the separation of slow moving traffic from the fast moving traffic, either by lanes on the streets and highways, or by the use of separate streets. Commercial vehicles should not be barred from any street, in the view of the committee however, until suitable alternate routes have been designated and are found to be equally suitable.

Pedestrian Movement.—The pedestrian movement and convenience is found by the committee to be one of the complex and difficult phases of the congestion problem. In some congested districts, the committee asserts, the traffic problem involves the pedestrian more than it does the movement of vehicles. In downtown Philadelphia 34 per cent of the persons crossing intersections were in vehicles and 68 per cent were on foot at the time the survey was made.

The pedestrian movement requires the most careful attention as an aspect of the problem, the committee continues. It finds also that opinion is divided on the question of whether pedestrians should be required to obey the traffic laws and signals. The committee adds:

"It is obvious that there is need for much greater cooperation between pedestrian and motorist. Motor traffic making turns has a tendency to disregard the right of way of pedestrians proceeding on a green light, and when signals change, drivers frequently overlook the necessity of permitting pedestrians to reach a place of safety. Pedestrians far too generally disregard the traffic signals either by proceeding heedlessly through lines of lawfully moving vehicles, or by crowding out in such manner as to retard the traffic flow."

Enforcement of Regulations.—The committee finds that effectiveness of regulations of control depend in a large measure on proper enforcement. It says:

"Effective enforcement requires complete cooperation of traffic officials, police officials and the courts. The establishment of arbitrary regulations which are not of benefit to the general public, lax or discriminatory enforcement of regulations by police officials, political interference or the failure of the courts to work with police officials will result in failure of enforcement and render ineffective the regulations that have been established."

Proper education of the public in these matters, through newspapers and the activities of civic organizations, will go far in the opinion of the committee in establishing respect and obedience to traffic control methods.

Aggressive and intelligent leadership is pointed out by the committee as an essential requisite to the execution of measures for the relief of traffic congestion. To be effective, the committee declares it must be accomplished by definitely placing responsibility, with technical guidance and public support.

9th Annual Asphalt Paving Conference to Be Held at Memphis

At a meeting of the Board of Directors of the Asphalt Institute, June 3, in New York, the city of Memphis, Tenn., was selected as the meeting place for the 9th Annual Asphalt Paving Conference. The meeting will convene on Monday, Dec. 1, continue through Dec. 2, 3 and 4 and close on Dec. 5.

The Association of Asphalt Paving Technologists will, as usual, meet in conjunction with the conference.

The arrangement will be in charge of various national and local committees created for the purpose. O. I. Kruger, City Commissioner of Memphis, and W. B. Fowler, Memphis City Engineer, are assisting in organizing the committees which will have charge of the local arrangements. An elaborate entertainment program is being planned.

From 1,000 to 1,500 engineers, technologists, public officials, contractors and asphalt producers are expected to be in attendance, since an effort this year will be made to break all previous attendance records.

Previous asphalt paving conferences have been held in Atlanta, Ga.; Louisville, Ky.; Denver, Colo.; Detroit, Mich.; Washington, D. C.; New Orleans, La., and West Baden Springs, Ind.

Roads in New Brunswick, Canada, in 1929.—The expenditure on roads and bridges for the year 1929 amounted to approximately $5,795,744 for highways and $750,000 for bridges. Provided the New Brunswick Legislature passes the bill for permanent road construction, beginning in April, 1930, the plans of the Minister of Public Works of the Province of New Brunswick will be put into execution. The bill will provide for the expenditure of $10,000,000 for hard surfaced main trunk roads in New Brunswick. The work will extend over a period of five years.

Flow Over Embankments During Floods

Results of Experiments for Developing Formulas for Use in Calculating Quantity of Flood Water Flowing Over Embankments

A KNOWLEDGE of the quantity of water that flows down a given valley during extreme floods is often a matter of considerable importance to the engineer. It is one of the fundamental bases of design, not only of railroad and highway embankments across such valleys, but of works planned for the protection of agricultural land and of cities and towns. Engineers, therefore, should avail themselves of every opportunity to obtain reliable data on this subject.

Highway and railroad embankments across river valleys generally act as barriers to the flow of flood water and often are overtopped during the highest floods. At such an embankment the total discharge is the sum of that through bridge, trestle, and culvert openings, and that flowing over the embankment. The discharge through a bridge opening during a flood may be computed with a fair degree of accuracy if the drop-down at the bridge opening is known. A highway, railroad, or levee embankment over which water is flowing may be treated as a broad-crested weir. Therefore, if the proper coefficient for a particular type of embankment is known the quantity of water flowing over an embankment of that type may be determined with reasonable accuracy. An investigation to determine these coefficients for certain types and widths of embankments so that the usual formulas for computing flow over broad-crested weirs could be employed has been conducted by the Bureau of Public Roads of the United States Department of Agriculture and the State University of Iowa at the university hydraulic laboratory. The results of 572 experiments on the flow of water over full-size sections of embankments are given in the April Public Roads, in a report by David L. Yarnell, Senior Drainage Engineer, U. S. Bureau of Public Roads, and Floyd A. Nagler, Professor of Hydraulic Engineering, State University of Iowa. The matter in this article is taken from the above-mentioned publication.

The Model Embankment.—The hydraulic laboratory of the University of Iowa is located on the west bank of the Iowa River, at the university dam. The principal testing canal is 190 ft. long, 10 ft. wide, and 10 ft. deep. At the upstream end of the canal, where it joins with the end of the dam, is a wooden head gate 10 ft. wide by 12 ft. deep. A 10-ft. weir of the suppressed type for measuring flow in the canal is located 60 ft. down-stream from the head gate. Numerous baffles were placed in the canal immediately below the head gate to obtain uniform velocity distribution as the water approached the weir, and a smooth flow over the crest. Similar baffles were placed in the canal immediately downstream from the weir to prevent commotion of the water as it approached the embankments.

A full-size section of a single-track embankment, 10 ft. in length, was built in the testing canal 92 ft. downstream from the weir. The embankment proper consisted of a wooden structure which was covered with gravel and upon which was placed the standard depth of gravel ballast and the ties and rails. The American Railway Engineering Association specifications for standard single and double track, gravel ballast, were followed. Seventy-pound rails were used. The top of rail of the single track was 3.8 feet above the floor of the canal. The embankment without rails corresponds to a highway with approximately a 12-ft. roadway.

In building the double track the extra track was added to the upstream side of the single track, the distance center to center of tracks being 13 ft. The height of the top of rail of the double track, however, was only 1.8 ft., as the floor here is 2 ft. higher than the floor in the downstream end of the canal. This difference is due in part to a false wooden floor placed in the canal for use in connection with other experiments. The double track embankment, without rails, is representative of a highway with a roadway 23 ft. wide.

Twenty-seven staff gauges, graduated to hundreths of a foot, were placed along the walls of the canal at frequent intervals, 14 being placed along the west wall and 13 along the east wall. The zero of these staffs was set level with the top of rail.

A bear-trap weir 6 ft. high and located 22 ft. downstream from the center of the single track, or 28.5 ft. from the center of the double track, was used to regulate the water level downstream from the embankment, and in some experiments to submerge the embankment. This weir was hung on hinges and was regulated by means of a block and tackle attached to a windlass.

The downstream face of the embankment was grouted. This was done to prevent the material from washing off of the wooden base.

The side slopes of most highway and railroad embankments are covered with a heavy growth of glass and weeds which resist erosion.

The Tests.—Tests on each embankment were begun with a head of 0.5 ft. of water discharging over the measuring weir, and continued with successive increases of 0.1 ft. in head on the weir, until the maximum flow was obtained. For each head on the measuring weir the following conditions of outflow were imposed by means of the bear-trap weir: (1) With water surface on the downstream side of the track raised until the ratio $\frac{d}{D}$ (depth of water over rail on the downstream side of the embankment, to depth on upstream side of embankment as illustrated on drawings) was about 0.95; (2) with $\frac{d}{D}$ less than 0.95 (obtained by gradually lowering the bear-trap weir); (3) with water discharging freely over the embankment, thus simulating free flow over one type of broad-crested weir.

In each test a constant head was first obtained on the measuring weir and then the bear trap was adjusted to obtain a definite ratio of depth of flow. When this had become constant, one observer first took readings on the weir hook gauge and weir staff, then successively read the staffs downstream on one side of the channel and upstream on the other side. After determining that the readings on the two opposite upstream staffs checked, he again took readings on the weir hook gauge and weir staff. In the meantime, another observer plotted a profile of the water surface. Horizontal lines 0.1 ft. apart, as well as vertical lines 1 ft. apart, has been painted on both sides of the canal. By means of these continuous gauge lines an accurate profile of the many variations in the water surface was obtained which it was not possible to obtain with the staff gauges. This method gave a record of the waves caused by the rails.

In testing the single-track embankment with rails in place it was noted that a standing wave was sometimes formed over the downstream rail. To determine the effect of the downstream rail on the flow some tests were run with only the upstream rail in place. On the double-track embankment tests were also run with the upstream track in place and the downstream track removed.

The results of the test were computed as the experiments were under way, thus making it possible to rerun any doubtful tests.

Formulas Derived for Various Conditions of Flow.—The following basic formula was used in all of the computations:

$$Q = CLH^{3/2} \qquad (1)$$

In this formula,

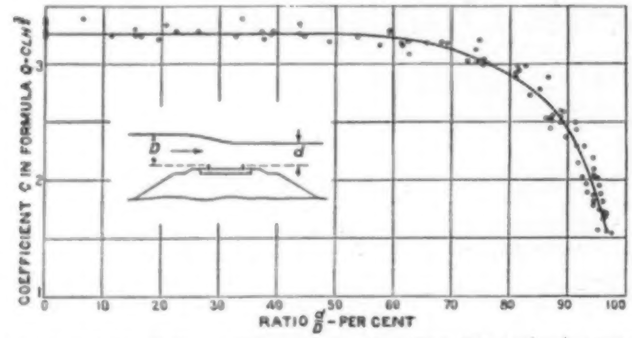


Fig. 1—Relation Between Coefficient and Per Cent Submergence, Single Track, Both Rails in Place

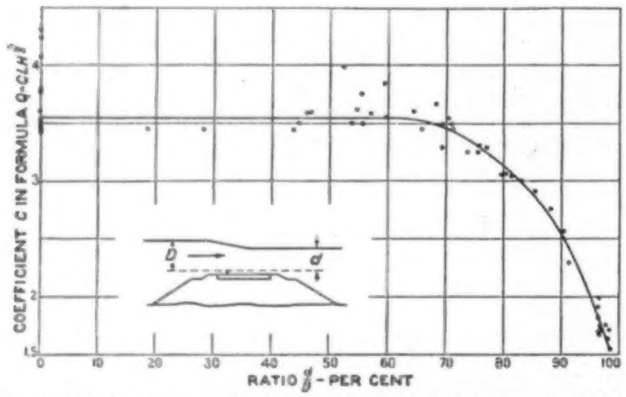


Fig. 2—Relation Between Coefficient and Per Cent Submergence, Single Track, Downstream Rail Removed

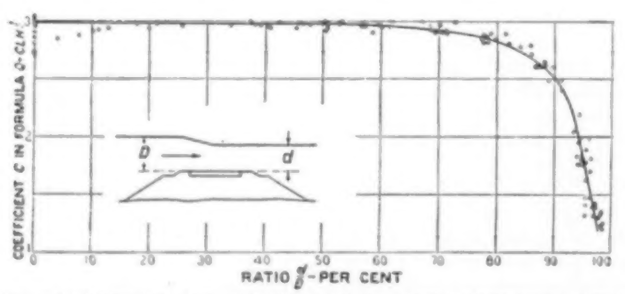


Fig. 3—Relation Between Coefficient and Per Cent Submergence, Single Track, Both Rails Removed. Equivalent to a Highway Embankment with a 12-Ft. Roadway

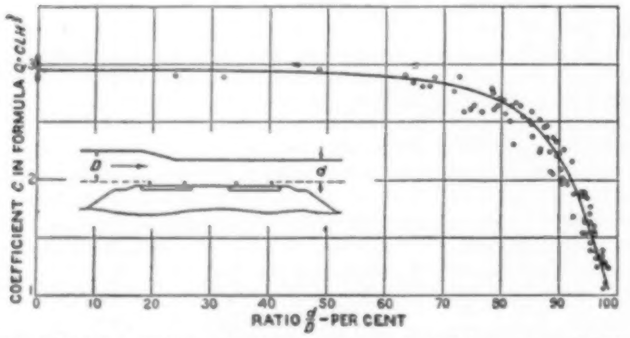


Fig. 4—Relation Between Coefficient and Per Cent Submergence, Double Track, Four Rails in Place

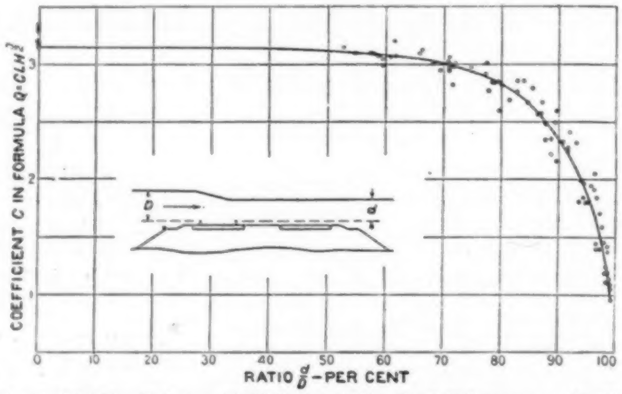


Fig. 5—Relation Between Coefficient and Per Cent Submergence, Double Track, Two Downstream Rails Removed

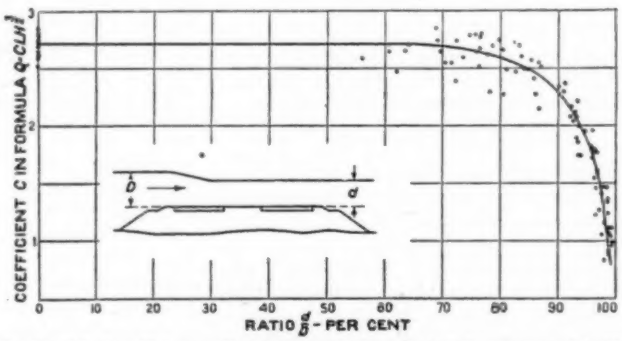


Fig. 6—Relation Between Coefficient and Per Cent Submergence, Double Track, All Four Rails Removed. Equivalent to a Highway Embankment with a 23-Ft. Roadway

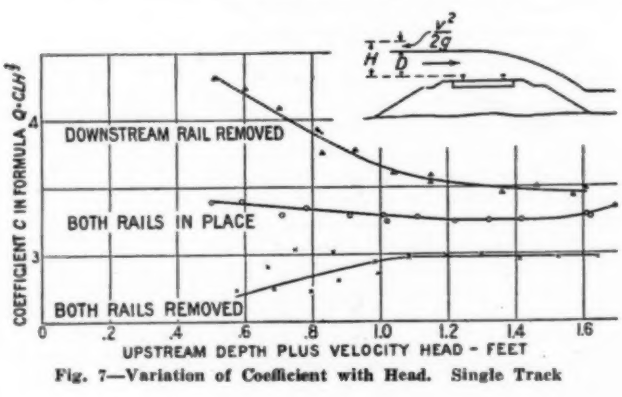


Fig. 7—Variation of Coefficient with Head. Single Track

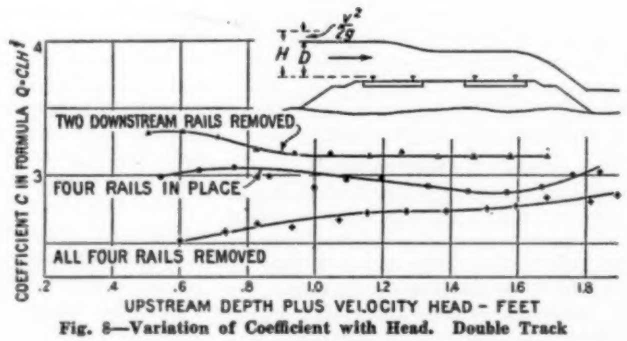


Fig. 8—Variation of Coefficient with Head. Double Track

Q=volume of discharge per unit of time,

C= an empirical coefficient,

L=length of the embankment overflowed,

H=the head corrected for the effect of the velocity of approach; i. e., measured depth plus $\frac{V}{2g}$ where V is the mean velocity of approach to the weir.

The discharge over the measuring weir was computed by Bazin's weir formula. The readings on the various staffs gave the heights of the water above the top of rail. In the tests on the embankments with the rails removed the height of the rail was therefore added to the staff readings to get the depth of water on the embankment.

For the tests in which the embankment was submerged the degree of submergence is expressed by the ratio $\frac{d}{D}$ before mentioned.

The results of the experiments were plotted on cross-section paper with the ratio $\frac{d}{D}$ as abscissas and the empirical coefficient C as ordinates. These curves are shown in Figs. 1 to 8, inclusive. It will be noted that when $\frac{d}{D} = 0$, the water flowing over the embankment has a free drop. Under such conditions the coefficient C varies more for some embankments than for others. For example, in Fig. 5 the points are grouped whereas in Fig. 2 they are more scattered. Since it was impossible to show all such values of the coefficient on the diagrams (many of them coincided), the points through which the curves are drawn were determined in the following manner: Values, the discharges, Q, were plotted on logarithmic paper as ordinates and the heads, corrected for velocity of approach, as abscissas. A line having a slope of 3/2 was drawn through the majority of the points, the greater weight being placed on the higher heads. The intercept on the unity vertical axis was taken as the value of C through which the curve should pass.

During the progress of the tests it was observed that for values of $\frac{d}{D}$ less than 0.6, the coefficient was practically constant since the elevation of the tailwater had no effect on the height of the headwater. This was due to the fact that the critical velocity occurred at the downstream edge of the embankment. Therefore, to conserve time in experimenting on some of the embankments, comparatively few tests were run with values of $\frac{d}{D}$ between 0.1 and 0.5.

For those tests in which the water had a free drop over the embankment it was noted that the coefficient varied somewhat with the head when the exponent of H was taken as 3/2. This variation is shown in Figs. 7 and 8 in which the coefficients have been plotted as ordinates and the heads as abscissas. These curves show that the exponent of H is not exactly 1.5. The test data were therefore plotted on logarithmic paper with the discharge Q as ordinates and the head H (corrected for velocity of approach) as abscissas. Lines were drawn through the points and the discharge equations determined for the various types of embankments.

The equations as determined for free flow over the embankments are as follows:

Single track, both rails in place—

$Q=3.27\ LH^{1.47}$ ....(2)

Single track, upstream rail only in place—

$Q=3.66\ LH^{1.37}$ ....(3)

Single track, both rails removed—

$Q=3.00\ LH^{1.49}$ ....(4)

Double track, all four rails in place—

$Q=2.95\ LH^{1.47}$ ....(5)

Double track, upstream track only in place—

$Q=3.17\ LH^{1.48}$ ....(6)

Double track, all four rails removed—

$Q=2.66\ LH^{1.60}$ ....(7)

Use of Formulas Illustrated by Examples.—These experiments have made available coefficients for use in hydraulic formulas for computing the flow over embankments during floods. When free flow exists over an embankment one of formulas (2) to (7) may be used, depending upon the type of the embankment. If the embankment is submerged the appropriate coefficient may be taken from the curves shown in Figs. 1 to 8, after the percentage of submergence has been determined. In all of the computations for the curves and formulas the head corresponding to the velocity of approach has been added to the depth of water over the embankment to get the true head. Thus these coefficients are applicable to all embankments regardless of the velocity of approach. In a specific case, however, the velocity of approach must be assumed in the preliminary calculations and the assumed value checked after the discharge has been computed. This procedure can best be illustrated by practical examples.

Example 1.—Assume that water has been discharging over a single-track railroad embankment. The track at elevation 75 was not washed out. After the flood a survey for high-water marks showed that the water on the upstream side of the track had been at elevation 76.6, and on the downstream side of the track at elevation 74. Assume the height of the embankment (to top of rail) above the natural ground surface to be 6.5 ft., and for convenience consider a length of 100 ft. of track. The formula applicable to this problem is equation (2) which is

$$Q=3.27\ LH^{1.47}$$

in which

$$L=100 \text{ ft.}$$

The measured head is 1.6 ft. Assume the velocity of approach to be 0.80 ft. per second, then

Velocity head=0.0099
Total head, $H=1.61$

and

$$Q=3.27\times100\times1.61^{1.47}$$

or

$$Q=658 \text{ cu. ft. per second.}$$

But the cross-sectional area of flow is 810 sq. ft. and

$$\frac{Q}{A}=\frac{658}{810}=0.81 \text{ ft. per second,}$$

which approximates the assumed velocity of approach.

Example 2.—A single-track railroad was overtopped by flood water. A survey showed the track to be at elevation 50, the water level upstream at 53, and downstream at 52.5. The height of the embankment or top of rail is 3.5 ft. above the natural ground surface, and the length of track overflowed 100 ft. The percentage of submergence would then be

$$\frac{d}{D}=\frac{2.5}{3.0}=83.3.$$

From Fig. 1 the coefficient, C, is found to be 2.80. Hence the formula would be

$$Q=2.80\ LH^{3/2}$$

in which

$$L=100.$$

The measured head is 3 ft. Assuming the velocity of approach to be 2 ft. per second, the velocity head is 0.0622 and the total head, H, is 3,0622.

Thus

$$Q=2.80\times100\times3.0622^{3/2}$$
$$Q=1{,}500.$$

The area of flow is 650 sq. ft. and the velocity of approach is $\frac{1{,}500}{650}=2.31$ ft. per second. The first assumption being too small, assume the velocity of approach as 2.3 ft. per second. The velocity head then is 0.0822; and the total head, $H=3.0822$.

$$Q=2.80\times100\times3.0822^{3/2}$$
$$Q=1{,}515.$$

The velocity of approach is $\frac{1{,}515}{650}=2.33$ ft. per second which agrees quite closely with the second assumption. Thus the discharge over a 100-ft. section of the track is 1,515 cu. ft. per second, or 15.15 cu. ft. per second per lin. ft. of track overflowed

Regulating Road Traffic in Chile.—As a result of the Chilean Government's road building program to unite the different parts of the country with a system of highways, existing legislation on the regulation of traffic has been found inadequate. Under the municipality law, each municipality has the right to regulate traffic within its confines, which has proved troublesome and caused confusion to transient traffic. In order to obviate the difficulties arising from this condition, the government has appointed a committee to study the entire problem of traffic regulation, to prepare a general traffic law and recommend the organism necessary to assure its application, as well as to outline the conditions or requirements necessary for acquiring drivers' vehicle licenses.

Resurfacing Streets by Heater Method

Surface Heater Method of Repairing and Resurfacing Asphalt Pavements

By R. A. MacGREGOR

Engineer in Charge, Division of Maintenance, City of New York

THE method of resurfacing of asphalt pavements on a large scale came to my knowledge in 1910 or 1911. Brooklyn City was using it then, as well as others as far west as the Pacific Coast.

The Borough of Manhattan did not begin its use until 1915, but since then has gradually increased each year the area covered until now 200,000 to 250,000 yd. are resurfaced each season. Considerably over 1,000,000 sq. yd. of sheet asphalt and asphalt block have been resurfaced in Manhattan up to date.

When sheet asphalt or asphalt block pavement has been in use 10 to 15 years, it is likely to have a rough and irregular surface due to openings, settlement and actual wear and tear. Yet what is left has life, as it is called, in it still, and the portion left will be mainly the binder with an added portion of fine material down to and including 200 mesh material obtained from the top wearing surface, and the attention of the aggregates in the binder.

The aim of the resurfacing is to obtain a new wearing surface, healing up to some extent the cracks and cuts in the old pavement, and replacing the amount of wearing surface actually worn off. This brings the top up to meet the grade of manhole heads and other metal boxes in the street, and gives an actual added life to the pavement almost equal to that of the original pavement.

The original Lutz heaters had a steam boiler for operation of the entire machine, and the vaporization or atomizing of the fuel. The heat was generated in a large combustion chamber and the flame did not reach the pavement. As internal combustion engine became more common and more reliable, the steam gave way to gasoline operated engines and the fuel for heating was merely vaporized or atomized under pressure in a burner directly under the hood. This makes a much simpler machine than the original, though it has departed entirely from the idea that only indirect heat should reach the pavement and not the flame. At least one indirect heat machine is now on the market, and both have been used by the writer with satisfactory results.

With either machine it is essential for good results that the old surface of dirt and grease be entirely removed and a fresh, clean asphalt surface obtained for the new top. This is done by the use of heavy toothed hoes taking off the old and burnt material, raking the pavement immediately after the moving of the heater. The material removed has very little good bitumen in it usually, though occasionally some of it can be used for filling small holes. Its suitability is easily determined by its strength after cooling. Examination of samples cut out from resurfaced streets occasionally shows clean sand without any film of bitumen. Here the scraping was not done carefully enough to remove all the dead or burned material. Since the men have been more carefully trained, very little peeling of the new top has occurred, and, in fact, in many streets the top course has worn down to the old surface before any peeling was found.

Perhaps the greatest advantage in the use of the surface heating method is the rapidity with which the new paving is done. While the saving in cost to the city is quite material, the saving in cost to the community is much greater. The interference to traffic is only partial for 8 hours a day for two or three days in a city block against the entire closing to traffic for a week to ten days at least, and in many places for a month or more.

In Manhattan, with an 8-hour day carefully observed, and work carefully done, both as to heating and rolling, 800 to 900 yd. a day is our average. Reports from other towns gives a much larger output, usually by contractors, probably with a 9 or 10-hour day, and with less careful work.

The cost in Manhattan, in the last five years, has varied from $1.10 to $1.25 per square yard, while the cost in the same years for asphalt pavement, only, without foundation, has varied from $2.75 to $3.40. The cost of resurfacing includes all street and plant labor, transportation, a percentage for overhead salaries up to and including the engineer of maintenance, and all materials, including fuel oil. It does not include the cost of electricity or water in the asphalt plant, depreciation, interest on investment for land and plant or insurance for accident or Workmen's Compensation. All of these, of course, have to be included in the contract prices for new asphalt pavement.

The new wearing surface averages from 1¼ in. to 1½ in. in thickness. Where the old pavement requires more thickness to obtain a proper crown, close binder is used to give more stability than would be obtained with the same thickness, all top mixture.

Owing to the danger of damage to the curb a strip about 1 ft. wide is cut out by pneumatic hammers and a similar strip is cut along rails, as the heater cannot be operated up to the rail without interfering with street car traffic. These strips are replaced with close binder up to 1½ in. from finished grade.

Owing to the well compacted lower course so compressed during years of traffic use, the new wearing surface receives better compression than a new pavement. At least, this is my theory. Tests for density show higher results and the surface after rolling shows fewer waves. Of course, the latter might be due to the care given to the rolling by our men, who are not pushed and who are picked from 18 or 20 rollermen in the Manhatten force.

In the years 1915 to 1918, 262,000 yd. were resurfaced. Of this, ten streets with an area of 29,700 yd., or about 11 per cent, were given a second resurfacing in 1927, showing a life of 9 to 12 years.

The average life of these ten streets prior to the first resurfacing was 11 years, all being very heavily travelled streets. This proves the value of resurfacing. It is to be considered also that the work done in the first few years was not up to the standard now obtained.

Acknowledgment.—The foregoing is an abstract of a paper presented at a meeting of the Engineers' Club of Philadelphia.

British Columbia Proposes to Reclassify Highways.—The Premier of British Columbia has announced that at the next session of the Legislature authority will be requested to reclassify all highways in the Province, the main thoroughfares to be termed "arterial highways," which will be constructed and maintained entirely by the Provincial Government. This plan, it is said, will enable the Government to proceed with a comprehensive highway construction program involving millions of dollars, which is not possible under the present plan requiring contributory support from property owners in rural districts.

New Traffic Signals at Pittsburgh.—Pittsburgh has a new installation of an automatic, flexible, progressive system of signal lights downtown. It is reported that more than 20 per cent greater volume of traffic is now moving at a speed 22 per cent faster.

Every Day Happenings on Ordinary Road Jobs

An Interesting Narrative with Illustrations Showing How Various Problems Were Handled

ON nearly every construction job minor problems arise that require much ingenuity for their solution. How problems arising on some of the construction contracts of the Owen P. Williams Construction Co., Inc., were handled is told by Mr. Charles T. Fisher, engineer of the company, in a recent issue of "The Low Bidder," from which the matter following is taken:

On a contract in Delaware County a 40 ft. span I-beam was to be built on the site of an old truss bridge. A temporary bridge was required to accommodate traffic during construction, so it was decided that the old bridge could be moved down the creek and used for that purpose.

Fig. 1—The Track for Moving the Bridge

Fig. 2—The Steam Shovel Was the Motive Power

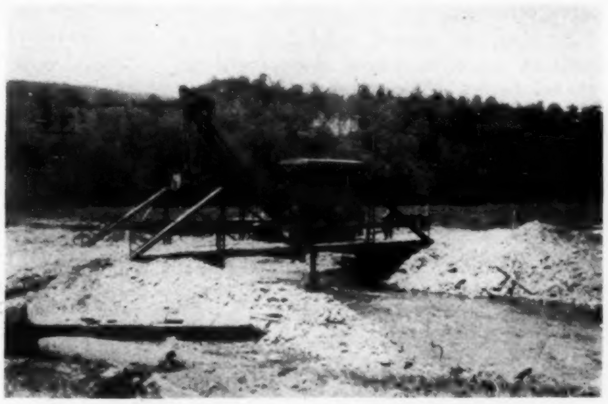


Fig. 3—Temporary Bridge Was Strong Enough to Carry a Power Shovel

One of the 26 in. I-beams which had been delivered for the new bridge was laid flat on each bank of the stream (Fig. 1), a steam shovel moved up the creek bed for motive power, and the old bridge, after braces had been placed between the trusses (Fig. 2), was dragged down the I-beams, using form pins for rollers, to its new position on crib-work abutments. The advantage of having a strong temporary bridge is shown by the photograph, which shows a power shovel going across (Fig. 3).

Fig. 4—This Came Out of the Abutment Excavation

This moving operation was not a difficult one, and it was performed in a very short time, but a heavy storm the following evening washed so much gravel around the treads of the steam shovel that it took all day to get it out, and before the water went down the bridge foreman, Kennon Peck, caught a 4 lb. trout out of the east abutment excavation (Fig. 4).

There was always plenty of water at this particular bridge. The abutment footings went down quite a distance below the gravel bottom of the stream, and keeping water out of the pits was impossible. It came up through the bottom faster than any available battery for pumps could take it out. So the main part of the stream was diverted to the opposite side of the channel, and both footing forms and concrete successfully placed in about 4 ft. of still water (Figs. 5

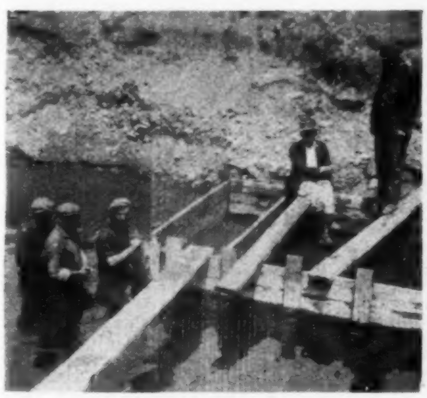


Fig. 5—A Job for the Inspectors

Fig. 6—Depositing the Concrete with Tremie

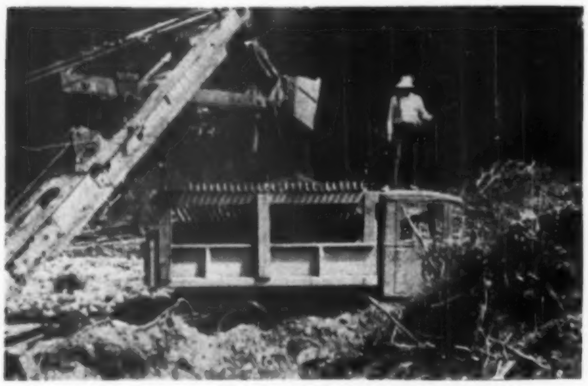


Fig. 7—Separating the Cobbles and the Gravel

Fig. 8—The Road Had No Soft Shoulder

and 6). There were always inspectors enough to hold the forms down, and an approved tremie was used for depositing the concrete, which carried an excess of cement and was mixed for three minutes.

A piece of gravel road had to be built in a section where there were no gravel banks. The only available material for the surfacing was in the stream beds, and this was composed of a little gravel and a lot of cobblestones.

Wooden racks were built on several truck bodies, and the shovel in the creek dropped the gravel through the racks into the trucks (Fig. 7), the cobbles rolling off at one side. This scheme took out the cobbles very nicely, but it made the loading so slow that it proved cheaper to load the material just as it same from the creek and pick out the cobbles by hand as the gravel was spread. When this picking was finished there were cobbles piled high on both sides (Fig. 8). No soft shoulders on this road.

Fig. 9—Not Ornamental, but Useful for a Fore-Sight

Fig. 10—Stone for the Concrete Was Obtained Here

Near Pepacton, N. Y., a side hill cut containing about 45,000 cu. yds. was taken out in 1929. The engineers were afraid that serious slides would occur as soon as the surface was disturbed, but the material proved to be hardpan of the toughest kind, and the whole cut had to be loosened by blasting before the 50-ton shovel could dig. A well drill was used for the deep holes (Fig. 15), which went down 35 or 40 ft., but most of the drilling was done by hand, two men using a churn drill to put down holes 10 to 12 ft. The deep holes were loaded with 200 lb. of black powder, and the shallower ones took from 50 to 75 lb. These charges shattered the soil without throwing any of it out, and about doubled the output of the shovels.

The 20 ft. pinnacle of hardpan shown in the picture (Fig. 9) would have resembled the formations in the Bad Lands if the marks left by the dipper teeth had been horizontal instead of vertical. This pinnacle was left intact for some weeks so that the engineers could use a spike driven in its summit for a fore-sight.

On the same road there was another heavy side hill cut, this time in rock

Fig. 11—How the Crushed Rock Was Conveyed to Trucks

Fig. 12—Washing Out the Dust

Fig. 13—The First Part of the House Moving

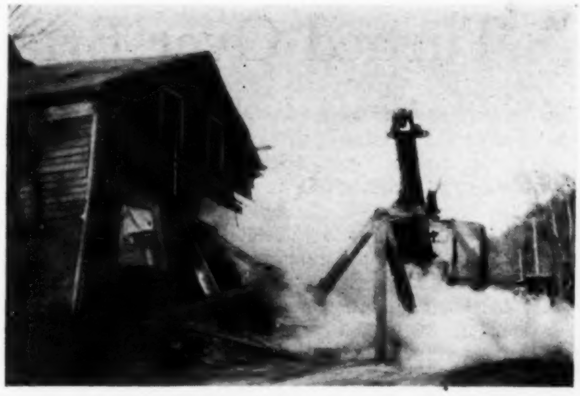


Fig. 14—Another Stage in the House Moving

(Fig. 10). The stone, which was a bluestone of excellent quality, was accepted for concrete, so a crushing plant was set up on the down hill side of the cut where the rock began. No elevated bins were needed, as the stone could be run down the side hill, confined by a sort of heavy fence (Fig. 11), and drawn out through ordinary chutes into trucks which stood on the old highway, which ran at the foot of the slope. A large quantity of stone could be stored with this arrangement.

A dust chute carried the dust over the old road into the river, but when the stone from this plant was first used it was thought necessary to wash out with a hose what little dust had missed the chute (Fig. 12). Later on, when the summer winds became stronger, this stone washing was discontinued.

At another bridge a sort of rotating batch box, probably modeled after a churn, was required to secure exact volumetric proportions for the concrete aggregates. Stone or sand was shovelled into the box, the crank was turned to dump it into a wheel barrow, and then sometimes a little more had to be added to make good concrete.

An old house, a story and a half high, stood almost on the center line of the new road. The land under it had been acquired, but no provision had been made either in the right-of-way agreement or the road contract for removing the building. It was not worth moving away, and there were other buildings too close to permit burning it with safety. So it was left unmolested for some time, in the hope that either the state or county authorities might take some action. However, nothing happened, so one day when a considerable group of officials had gathered for another conference, a power shovel was moved up, the dipper hooked under a corner of the old house, raised up high (Fig. 13) and then dropped suddenly (Fig. 14). The shock was too much for the old building, and a few more passes with the dipper reduced it to kindling wood, easily carried away.

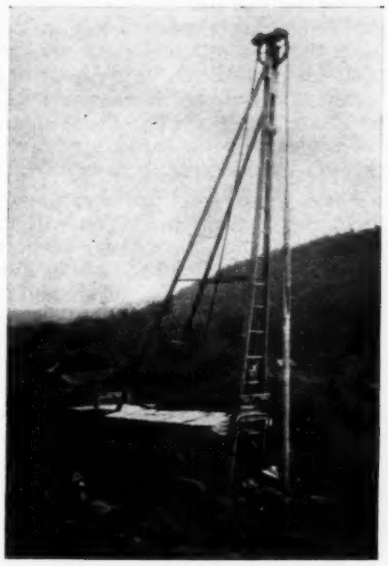


Fig. 15—Putting Down Deep Holes With a Well Drill

While this housemoving did not cost the taxpayers a cent, except for punctured tires from the nails which were scattered over the road, the method cannot be recommended for general use.

Committee on Airport Drainage and Surfacing Organized

The technical resources of the American Engineering Council, the American Road Builders' Association and the Aeronautics Branch of the Department of Commerce, insofar as they relate to airport engineering and contruction, have joined into one group to undertake the solution of the problems involved in one of the most urgent needs of airport development and air transportation—adequate drainage and surfacing for airports.

The three organizations have designated representatives to serve on a committee organized by Clarence M. Young, Assistant Secretary of Commerce for Aeronautics, and known as the "Committee on Airport Drainage and Surfacing," which will undertake, at once, a comprehensive and thorough study of the problems involved; collect and correlate available information and experience and present its findings and recommendations in a report that will serve as a working tool in the hands of engineers engaged in the development of air terminals, and also will meet the constantly increasing demand for information on this subject. The committee is under the chairmanship of Harry H. Blee, Director of Aeronautic Development, Department of Commerce.

The membership of the committee follows:

Aeronautics Branch, Department of Commerce: Harry H. Blee, Director of Aeronautic Development, chairman; A. Pendleton Taliaferro, Jr., chief, Airport Section; John E. Sommers, airport specialist, secretary.

American Road Builders' Association: Wm. A. VanDuzer, president of the American Road Builders' Association, and assistant chief engineer of the Pennsylvania Highway Dept., Harrisburg, Pa.; C. N. Conner, executive engineer of the American Road Builders' Association; Col. C. E. Myers, president of the City Officials' Division of the American Road Builders' Association and Director of Transit of Philadelphia; Henry H. Wilson, member of the executive board of the Associated General Contractors Division, and managing partner of Winston Brothers Company and H. H. Wilson, Harrisburg, Pa.; Charles M. Upham, engineer-director of the American Road Builders' Association and executive secretary of the Manufacturers' Division.

American Engineering Council: W. W. Horner, chief engineer, Sewers and Paving, City of St. Louis, Mo.; Archibald Black, president, Black and Bigelow, Inc., Air Transport Engineers, New York City; Perry A. Fellows, city engineer, Detroit, Mich.; C. A. Hogentogler, senior highway engineer, Bureau of Public Roads, Washington, D. C.; James H. Polhemus, chief engineer and general manager, the Port of Portland, Portland, Ore.

Turned Over Brick Pavement Construction

Method of Salvaging and Relaying Brick in Pavements Practiced at Toledo, O.

By HERMAN GEISER

Superintendent of Street, Lima, O.

IN Lima, O., we are turning our brick pavements over. We have found that brick streets that have been down from 20 to 35 years are not worn out; that they can be turned over and offer the same amount of service again at a small cost.

The turning of the brick pavement is not original in Lima. I don't know where it originated. I believe it was in Columbus, but we saw the opportunities and the possibilities of the brick pavements being turned completely over, and I believe we have profited to a great extent. In fact, we had inquiries in regard to our work in Lima from Australia and Germany, from all points in the United States, also Canada.

Our first street was turned approximately six years ago, and in the six years of service this street has not required any expenditure for maintenance.

Preliminary Work.—The first thing we do before we start work on one of our streets is to make a survey of the particular job we have in mind to turn. We note the deep depressions where there is a possible failure in the base. That location is logged on the street. We generally put our location mark on the curb. From observation, we can, make an approximate estimate of the replacement of brick we are going to need on that job. You just have to use a little common sense in figuring your loss from your own past experience.

Removing Brick.—The street then is barred loose. We generally bar four rows of brick at a time, pulling the fourth row out, so that when you go back to move forward the next four rows of brick it will not bind in and make it difficult for the men to work.

Sorting the Brick.—After we have opened our street we have men lined across the street who are acquainted with sorting brick. They are men who have been taught and understand just what you want on a job, and if you get your men educated to such a point that they will know just what brick you want in, right at the point where you are picking the brick off the street, you will make a considerable saving. The broken bats are loaded into trucks. These brick are never hauled over two blocks. We always find a market within the immediate vicinity for them. They are always used by the property owners adjoining the street or near that territory. They can use these brick for floors in their garages, for sidewalks or driveways on their property in which is a considerable saving to them. We do not use brick that are worn and have no parallel sides. The top of the brick and the bottom must be parallel. If they are worn off on a kind of angle, they are hauled to the city yard, where we use them for manholes, catch basins, and for cross walks in the far residence districts.

Cleaning and Grading Brick.—All the good brick that are taken out are piled along the side of the street. The new brick are spaced as we figure will be needed. The old brick are lined along the side and men are put there immediately, cleaning the brick. We clean with brick hammers.

While these men are cleaning the brick, they are graded. You will find, in the center of the street, or in the two quarters in the middle of the street, that the brick are worn off about ½ or ¾ in. Those brick are placed in a separate pile. The brick that go from the gutter toward the center of the street for a distance of 6 or 7 ft. are a part of the street that is rarely travelled, used generally for parking, and the brick are not worn as badly as those in the center. When we relay the brick, the gutter brick are laid to the center, and those that were in the center go to the gutter, so you have good brick in the center for wearing, and the ones that have been worn off already are put to the gutter.

Preparing Base.—The grade is established by your curb. The sand cushion we clean off the base. We don't use the old sand cushion over. We haul that out on public alleys. The sand, we found, is dirty, very musty. It is very hard work in the sand that has been removed, especially on a street where the brick were sand filled. After we get rid of the sand cushion, our base is examined. We get our field book and examine particularly well these places where we had these unusual depressions. If the base is bad in those particular places we replace the base and properly re-enforce it, so there is no danger of it settling. Then the new cushion is placed on the pavement.

We don't feel it is necessary to go into any further detail on the base. That base has been in there for 25 or 30 years and has given that period of service. We feel that that base is set. The ground beneath it is established and hard-packed, and we don't feel there is any chance for the base to go down any more unless there is a service cut or something that is going to cause trouble.

The New Cushion.—Then our new cushion is placed. We use limestone sand instead of lake sand. It is more compact. It will hold brick, because you have a worn surface to be held that has been turned down. You must have a good cushion. Lake sand, I believe, would not really do the work as well unless the sand were first dampened and then rolled in and held.

Most of the street of 20 to 35 years ago, we found have stone curbing. That stone curbing has probably been knocked out of grade in some places, so the best thing to do is to stretch your level down along your gutter, to your catch basin or water drain, so you will have the proper drainage, and from that point establish the crown of your street. I have never had to change a gutter but once, and that was due to a rise that was put in by a utility company, in putting in a conduit.

Laying the Brick.—We lay all old brick first, and then come in with the new brick separately, replacing those that were culled out. The bed is then made by keeping about 1 in. or 1½ in. of sand cushion in the center of your pavement, where you are putting in all full sized brick. We raise the sand cushion at the gutter line to take care of the thinner brick. As the men bring the brick out to the brick dropper, the smaller brick are placed to a point about 7 ft. from the gutter. From there across the center line we put in the larger brick. Our grade of cushion is again regulated to take care of the different size brick.

Rolling.—After the brick are laid in place they are rolled. I use a 5-ton roller on this pavement, because you need a heavy roller, and you can't afford to run over it very much. I use a 16-ft. straight edge. We straight edge from the gutter out, parallel to the curb of the street. Any bumps, irregularities, are chalked with keel and taken out or replaced, according to the grade, and rerolled. To make sure we have no bumps in the pavement, as we go on up the street leveling we lap about two feet with our straight edge.

We are then ready for our asphalt filler. That is what we have been using for the past five years. We use a squeegee bucket with blade, therefore leaving a minimum of asphalt on surface of brick. We have used about an average of 8 to 12 lbs. to the yard. It very seldom runs any more.

We have met with such wonderful success in the turning of our brick pavements in Lima that the property owners that adjoin the street are so pleased they have gotten the idea out of their minds that it is ever the fault

of the surface material that the streets were in such bad shape.

We have, in the past six years in Lima, relaid or turned over approximately 72,000 sq. yd. of brick pavement at an average cost of 97 ct. per square yard. Our percentage of salvage averages pretty close to 74 per cent.

Acknowledgment.—The foregoing is an abstract of a paper presented at 24th annual meeting of the National Paving Brick Manufacturers' Association.

The County Manager Plan

Definite need for a new type of governmental executive—a county manager—has been shown to exist by a survey conducted by the committee on county manager plan of the National Municipal League, Prof. Paul W. Wager of the University of North Carolina, secretary of the committee reported at the National Conference on Improving Government.

Opinion of experts in 31 states was unanimously agreed that the county demanded a stronger executive or chief administrator to direct its work. Sentiment in nine states was divided, and in six states the belief was that a strong executive was not needed. Four of the six states which answered in the negative, however, were New England states where the county has only a nominal existence.

"North Carolina and Virginia are the only states in which county managers are found, and the few managers in these states do not fully satisfy the definition of the term. In Albemarle County, Virginia, the highway engineer has been given additional duties, principally those of preparing the budget and keeping the books of fiscal control, and is designated as county manager. North Carolina has five county managers in name, though none of them meets the requirements of an orthodox manager. In two counties the chairman of the county board devotes his entire time to county work, acting as the representative of the board, supervising the finances, and performing the duties of a chief administrator. He is elected as chairman-manager in one case by the people and in the other case by the board. In another county the board has selected one of its members as manager but not the chairman. In two counties—Davidson and Robeson—the manager was chosen by the board from outside their own number. In every case the manager has rather large powers, but not the essential power of appointing all subordinates in the administrative service. This is partly because he has been willing to share this power with the board and partly because there are still several officials chosen by popular vote."

In presenting a preliminary draft of a model act providing for the adoption of the managerial form of county government, Professor Wager pointed out that there were three classes of counties—the urban, the urbanrural and the rural. For the urban counties, he recommended consolidation with the cities with which they so nearly coincide.

"The constitutions of many of the states have limited the counties to a single form of organization. This has been extremely unfortunate, for the needs of an urban county may be quite different from those of a rural county. The same is true to a lesser extent as between the urban-rural counties and the counties which are strictly rural. There is unquestionably a need for considerable flexibility of organization within and between the first two classes of counties. But there does not seem to be a need for any fundamental differences in organization among the counties of the third class. Infinite variety in the form of government of similar counties is quite as obstructive to good administration as rigid uniformity among dissimilar counties.

"Education has in most cities been left outside the jurisdiction of the city manager, for the reasons that it is a specialized field, has its own organization and administrator, and is related more closely to the state than to the city. In the counties it can be left outside the jurisdiction of the county manager for the same reasons.

"The conduct of elections is left outside the control of the manager in order that there can be no ground for accusing him of political manipulations.

"The courts are agencies of the state and should be entirely divorced from county business. Only to the extent that court officials handle county funds should they be responsible to the manager and the county board. The sheriff in his capacity as a court officer, the clerk of court, and the coroner should not be considered county officers. As conservator of the peace the sheriff is again more of a state officer than a county officer. The fact that his bailiwick is the county does not make him a county officer in any true sense. If the sheriff serves as jailer and in that capacity expends county funds he should to that extent become responsible to the county manager. The county prosecutor, or district attorney as he is called in some states, should also be considered a state officer. The county judge, where there is one, and the justices of the peace might be considered county officers but since they are, or ought to be, concerned mainly with the administration of justice they are not a part of the business organization over which the manager has jurisdiction. Of course, they should be accountable to the manager for any county funds which come into their hands.

The success of the county manager plan depends upon the application of the short ballot principle. Hence a model county manager law would provide for the appointment by the manager of all the administrative officers within the scope of his jurisdiction. If the departments of education and justice are left outside his jurisdiction many states could adopt the county manager plan without constitutional amendments. In some states there would remain only one of two elective positions within the administrative service and in a few states none at all. Of course, there are a number of states which could not adopt an effective manager system without changing the constitution.

The tentative draft of a model law presented to the county government committee at the conference provides that "the board of county commissioners shall appoint a county manager, who shall be the administrative head of county government and responsible for the administration of all the departments of the county government which the board of county commissioners has the authority to control. He shall be appointed with regard to merit only, and he need not be a resident of the county at the time of his appointment. No member of the board shall, during the time for which elected, be chosen manager.

The law roughly parallels the city manager plan, providing for the county board to be the policy-determining body, and the manager to run the administrative business of the county. The manager's job depends upon his record. If he makes good and carries on the business of the county efficiently and economically, he keeps it; if not, he is fired, as the manager of a business would be.

With respect to this, the tentative draft of the law specifies that "the manager shall not be appointed for a definite tenure, but shall be removable at the pleasure of the board. In case the board determines to remove the manager, he shall be given, if he so demands, a written statement of the reasons alleged for the proposed removal and the right to be heard thereon at a public meeting, of the board prior to the date on which his final removal shall take effect, but pending and during such hearing the board may suspend him from office. The action of the board in suspending or removing the manager shall be final.

The powers and duties of the manager would broadly be to serve as the administrative head of the county government, to attend all meetings of the board, and recommend such actions that he may deem expedient, to appoint subordinate officers, to fix for the approval of the board their compensation, to remove them, reporting such removal to the board, to supervise the assessment of property and the preparation of the tax roll, the purchasing of all supplies used by the county, except for the court and the schools, and similar and executive and administrative duties.

The Planning of Highways from Aerial Maps

Aerial Surveys: The Methods Used, Their Limitations and the Reasonable Accuracy to Be Expected

By S. D. SARASON

Professor of Civil Engineering, Syracuse University, Syracuse, N. Y.

THE early planning of the highway systems of this country presented a far different problem than that which confronted the pioneer engineers who built our railway systems. Our present system of trunk highways was generally built over well established main arteries of traffic. Comprehensive maps of the territory, even when available, were seldom used.

There were some notable exceptions in New York State, such as the Hutchinson and Bronx River parkways, the Storm-King Mountain road, and the Long Island roads which were built over new rights of way. In projects of this character, general maps are necessary, and aerial maps would best serve the purpose.

There will be an increasing demand for roads over new rights of way, as well as improvements in alignment, grade, and width of existing roads. Comprehensive maps are also necessary for planning a program of improvements for secondary roads to properly co-ordinate with the main lines of traffic. A mosaic compiled from a series of aerial photographs is especially suitable for highway planning.

The Pan-American Highway Conference of 1929 made a careful investigation of the highway problems of Mexico, Central and South America. They found very few existing means of transportation between the large centers of population in these countries, except by rail or water. They report very favorable topographic and climatic conditions, as well as an abundance of suitable highway material. However, this vast area has never been mapped. The planning of a highway system over virgin territory of this character cannot be done without the aid of topographic maps. Recent developments have made possible the construction of topographic maps from aerial photographs in less time and expense —and often more accurate—than by the usual ground methods.

In this country the annual cost of highway maintenance will soon far exceed the expenditure for new construction. Highway maintenance is being organized along the same system successfully used by railroads. This will require the services of many engineers. However, for those engineers who are endowed with the pioneering instinct and prefer the work of construction rather than maintenance, the South American countries will offer large fields for the skill gained by training and experience.

An official of the U. S. Geological Survey recently stated that after 47 years of the Survey's mapping activities only about 30 per cent of the area of the country is now covered by maps that are adequate for the present day uses. It is hoped that the application of aerial mapping will greatly increase the rate of progress of this important work.

Aerial Surveying by Contract Method.—Aerial photographic surveying is now being done by the contract method. It is hoped that the early experience of the Federal Bureau of Public Lands in contract surveying will not be repeated in this new field of mapping.

The engineer—contracting for such maps—should be familiar with the methods used, their limitations, and the reasonable accuracy to be expected. Fair competition can only be obtained from bidders on the same specifications. There is at present an urgent need for standard specifications for aerial surveys by a recognized technical committee. No greater degree of accuracy should be specified than is necessary for the purpose for which such a map would be used. In testing the compliance with such specifications, consideration should be given to the fact that ground surveys rarely possess the accuracy claimed.

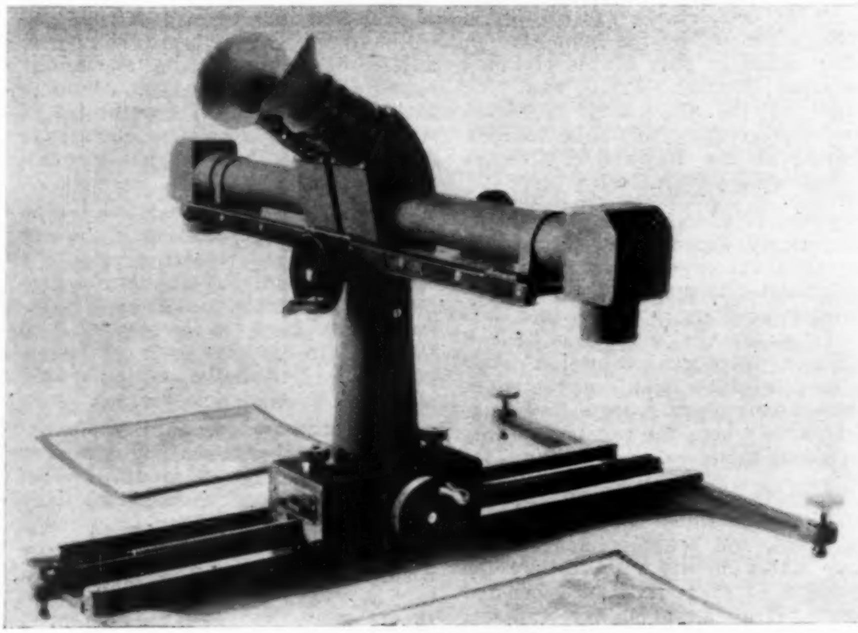


Fig. 1—Magnifying Stereoscope

162 Companies Engaged in Aerial Mapping.—The Federal Bureau of Aeronautics lists 162 companies distributed throughout the country engaged in aerial mapping. On closer examination it is found that most of those are commercial aviation companies who do occasional aerial photographic work incidental to their other activities. The earliest aerial maps were made with the cooperation of the U. S. Army Air service for the purpose of keeping its personnel in training. The early maps were a patchwork of photographs with very little ground control, and therefore not to scale. There are still large differences in the accuracy of the mosaics now produced.

Syracuse is the first American University to offer a complete program of instruction in aerial photographic surveying and mapping. It has complete office and field equipment for this work and is conducting a research program in its laboratories. This has been made possible by generous contributions from the Guggenheim Foundation for the Promotion of Aeronautics.

Photographic surveying, from photographs taken from known points on the ground with a phototheodolite, has had a limited application for many years prior to the introduction of the airplane. Photographs were taken on glass plates or film placed in a vertical position. Co-ordinates could be measured with a comparator instrument and by geometric principles it was possible to construct a map from photographs. The airplane has greatly broadened the field of application.

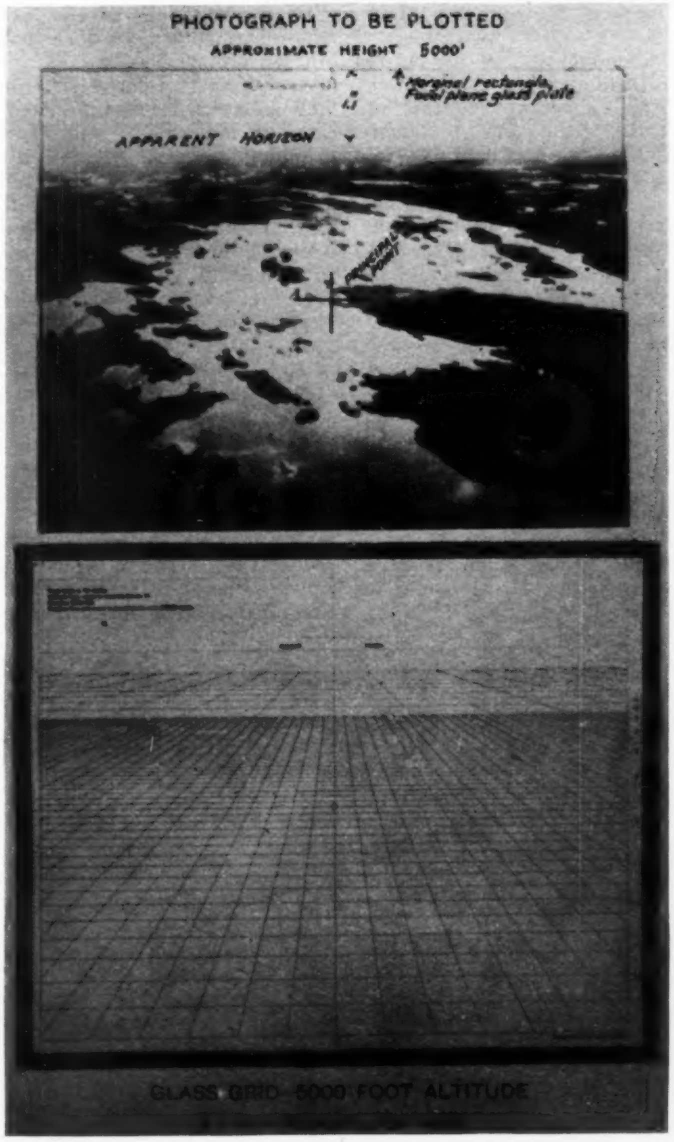


Fig. 2—Canadian Oblique View and Its Corresponding Grid

New Type of Map Produced by Aerial Photography.—It is possible to produce line maps from aerial photographs to any desired scale with contours to any required interval. However, aerial photography has introduced an entirely new type of map. It is made by assembling a series of aerial photographs—reduced as nearly as possible to the same scale—properly matched and oriented with respect to each other. This new product is called a "mosaic," and the great majority of the so-called "aerial maps" now being produced in this country are of this tyoe. It meets the requirements for the planning of many engineering projects, including highways.

There is in reality no possibility of having aerial photographs on a definite scale throughout, unless the exposures are made with the plates precisely horizontal, and unless the entire terrain is level. Even then, were the scale to be known, it would be necessary to know the focal length of the camera, and the exact height at the instant of exposure or to scale known ground distances. Of course, the ground never presents a level surface, and the other conditions are difficult to fulfill.

For instance, research has failed to disclose a method for holding the camera in an airplane so that the plate will always be horizontal. Level bubbles are attached to cameras the same as they are on transits, but they are affected by the unstable conditions of the airplane, and by changes in speed and direction of flight, and by inertia. Gyroscopic instruments have been tried to eliminate the tilt of the camera but without success. The amount of tilt may, however, be minimized to as small as one degree by a skillful pilot co-operating with an expert photographer using a suitable form of camera suspension.

The Taking of Aerial Photographs.—Photographs are perspective projections on which the scale is the ratio of the focal length of the lens to the height of the lens above the ground. It is, therefore, apparent that even if the absolute elevation of the lens at the instant of exposure were known, areas on the same photograph having different elevations will be shown to different scales. Very sensitive barometric altimeters have been perfected, but a simultaneous reading on the ground is required for the calculation of the elevation of the lens. Experiments are being made with radio waves for determining airplane elevations.

A solution of this problem would not only be of great value to aerial mapping but would also add greatly to the safety of flight, especially in fog when the ground is invisible.

A camera with a 12-in. cone—the commercial terms for focal length—will take a photograph on a scale of 1 in 5000 at a very moderate flying altitude for aerial surveying 5000 ft. above the ground. Photographs have been taken from altitudes of seven miles. The size of the usual photograph in American cameras are 7 in. x 9 in. with the 7 in. dimension in the direction of flight. Such a photograph with the focal length and altitude specified above will cover a width of 0.55 mile on the ground. Points near the center of the photograph suffer smaller displacements due to changes in elevation, while those at the edges are affected by the greatest amount.

The finer and more precise mosaic, which is sometimes termed an "aerial mosaic map," utilizes the central portion only of each photograph. An overlap of 50 per cent to 60 per cent in the direction of flight and 10 per cent to 30 per cent between flight strips is recommended. Under these conditions exposures would have to be made every 13 seconds for a ground speed of 60 miles per hour.

Due to the required frequency of exposure, as well as the additional weight of glass plates, film rolls are generally used, although a well established American firm has used plates successfully. The usual film is subject to variable shrinkage in the process of development, and an additional shrinkage occurs in the development of the paper contact prints used in the assembling of a mosaic. It is claimed, however, that an aerochrome film made in Germany, has a uniform shrinkage. This film is being used in the country and will soon be manufactured here.

For the reasons outlined above many engineers have been led to believe that mosaics were most inaccurate and unreliable. Practically, however, the majority of errors resulting from these difficulties are minor and corrections to each photograph taken in the air can be made in order that a final mosaic can be assembled in which none of these errors need exceed those caused by the expansion and contraction of the photographic paper and are often comparable to the errors encountered

in scaling a line map made on blueprint paper.

Some ground measurements are necessary for all aerial maps and those points which can best be identified on the photographs are preferred. Highway traverses and profiles are excellent controls for aerial maps. These are often available without any additional field work.

The inherent inaccuracies of the scale of a mosaic are fully compensated by the fact that it shows with greater accuracy such details as buildings, property lines, vegetation, density of population, traffic and a comprehensive relationship of the various possible solutions of the proposed project. The speed and the economy of aerial surveys are also to be considered. All the aerial photography required for a mosaic of the city of Syracuse, as well as a 20-mile strip to the south for a study of a flood prevention project, was executed in three hours on a single day. The rate of progress of the office work depends on the facilities of the mapping organization.

Use of Aerial Photographs in Traffic Surveys.—A highway traffic survey has been found to be of the greatest importance with the increasing demands for additional traffic lanes on existing highways. Aerial photographs have been used successfully for this purpose. A photographic strip flown over a highway during the period of greatest traffic will give data not obtainable by any other method. A relationship between the clearance and the speed of cars may be established. With this aid the discharge of vehicles per hour for various speeds may be determined. Those who advocate relieving traffic congestion by widening occasional stretches rather than the entire length of a heavily traveled route could easily verify the effectiveness of such an improvement by comparing aerial photographic strips taken before and after the improvement.

As previously outlined, the original photographs should have an overlap of not less than 50 per cent in the direction of flight. This makes it possible to view with a magnifying stereoscope (Fig. 1) the overlapping portions of two photographs taken from different positions of the camera. The area is then viewed in relief. The same optical principles are involved as those used in the old-fashioned parlor stereoscopes. In a good many cases a decision can be made between two or more possible routes by merely viewing the photographs stereoscopically. A preliminary thread location might be made under suitable circumstances. The stereoscope has been used for sketching contours when a sufficient number of ground points of known elevation can be located on the photographs.

Suggested Specifications.—The following specifications are suggested for controlled mosaics for highway planning:

A large size mosaic of the entire area for wall use on a scale of 1 in.=2000 ft. Atlas sheets to a scale of about 1 in.=500 ft. in sheets of convenient size for office and field use, for example, about 18 in. x 24 in. A complete set of prints from the original negatives. All necessary ground control to be furnished by purchaser. A tolerance of 1 to 2 per cent should be allowed between points about two miles apart on the mosaic and the corresponding measured distance on the ground. The photographic negatives should be left with the mapping contractor and terms fixed for additional copies when required.

Very often the final decision on a highway program is left to a nontechnical board, who can more readily visualize the problems involved from the large wall mosaic than from a series of the smaller sheets bound in an atlas.

Uses of Oblique Aerial Surveys.—Different mountings for an aerial camera permits the taking of an oblique as well as a vertical view. An oblique view shows relief to the naked eye because it indicates the profile of topographic features. It has a greater depth of field and very much larger areas are shown in single photographs. The photographs taken by Capt. McKinley in Admiral Byrd's recent flight to the South Pole were oblique views covering a width of about seven miles.

The Canadian Government has made extensive use of oblique aerial surveys in mapping their vast inaccessible areas of forest and lake country, which is generally of very low relief. The distance of the horizon line from the center of the plate permits the calculation of the tilt of the camera. The focal length of the lens and the height of the camera are the only additional data necessary for compiling by the principles of perspective geometry, a plotting grid diagram by which line maps

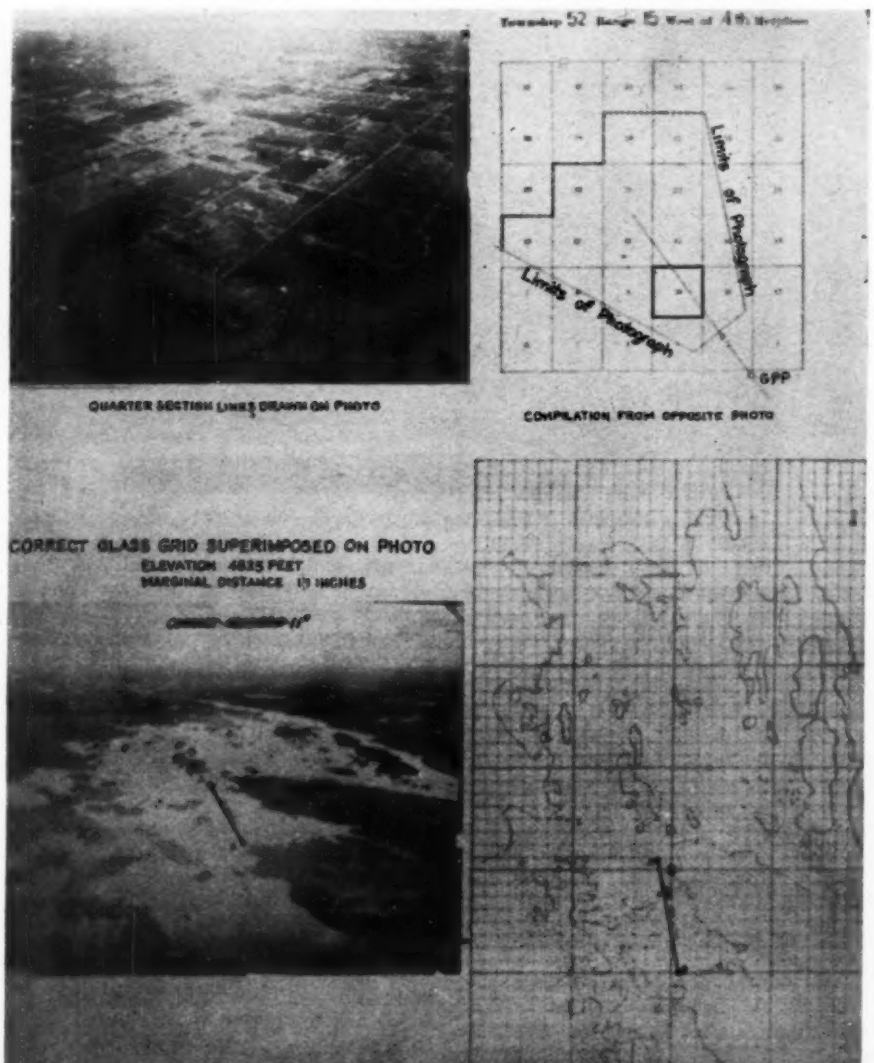


Fig. 3—Plotting Grid Superimposed on an Oblique Photograph and the Resulting Plot

may be constructed from the oblique views. Figure 2 shows a Canadian oblique view and its corresponding grid. Figure 3 shows the plotting grid superimposed on an oblique photograph and the resulting plot from same. No economic method has as yet been developed for plotting contours from oblique views. These Canadian maps drawn on a scale of four miles to the inch will undoubtedly serve as the basis for planning highways when sufficient resources are discovered to warrant the development of these outlying territories.

Oblique views are of special value in the planning of bridge approaches, as well as in studies for the elimination of crossings of highways by railroads at grade. An oblique view of a completed engineering project will convey more information to the average layman than is possible by maps and plans.

When highways are planned over new rights of way, a topographic map is indispensable. It is possible to compile topographic maps to a true scale from aerial mosaics. Photographs should overlap about 60 per cent in the direction of flight.

Two overlapping photographs are properly aligned for stereoscopic vision, and a cross hair or floating mark is made to touch the ground at an elevation of a contour line. The path of the floating mark when made to continue to touch the ground will describe the trace of a contour line. The trace may be drawn by hand on the photograph itself, as in one process developed in this country, or by a plotting system, directly to a map of any desired scale, in the various stereoscopic automatic plotting instruments made in Europe.

The aerocartograph (Fig. 4) is one of those European instruments which is being used by the U. S. Geological Survey. Fig. 5 shows a finished topographic map as well as the pair of photographs from which it was constructed with the aerocartograph by a commercial aerial mapping company in this country.

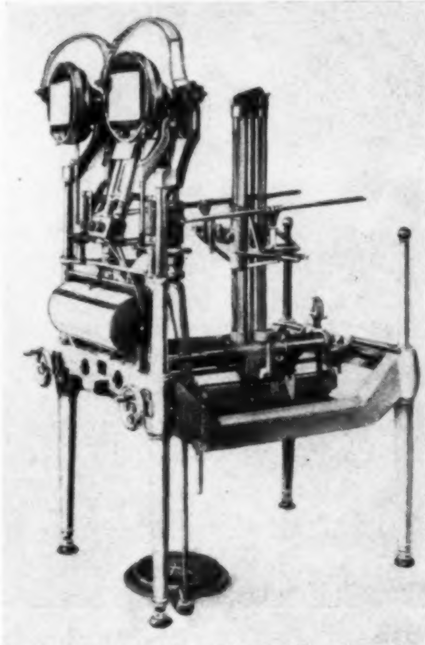


Fig. 4—The Aerocartograph

A Combined Range Finder, Stereoscope and Plane Table.—The stereoautotachygraph (Fig. 6) is a ground instrument, which combines a range finder, stereoscope and plane table. Directions, distances and elevations of objects may be determined and plotted with this instrument by merely viewing the object. The use of chainmen and rodmen are not necessary. It has been used successfully by an American contractor on railroad construction in Persia. It may be used economically on preliminary and final cross sections in highway construction, especially in difficult topography.

New Type of Aircraft.—The autogyro is a new type of heavier than air aircraft. It cannot be called properly an airplane, because it lacks the planes or wings. It is stabilized by a revolving overhead rotor, which resembles somewhat the overhead propeller of a helicopter. It is now being manufactured in the United States. It is claimed that it will take off and land in a distance of 100 ft. and can do 105 miles per hour with a payload of 400 lb. It has the additional qualities of being able to fly low and slow at a speed of 25 miles and a few feet off the ground, if desired, and at 12,000 ft. if necessary. It has a cruising radius of 500 miles. Such an aircraft may have possibilities of solving some of the present problems involved in aerial surveying and mapping. It has as yet never been tried for aerial photography.

Cost of Aerial Surveys.—The cost of aerial surveys depends upon a good many variable factors, such as size and shape of an area to be mapped, scale and accuracy desired, and the proximity to a photographic flying service. The published cost of the controlled mosaic of Greater New York, executed in 1924, covering an area of 600 square miles, is about $60 per square mile, while that of Los Angeles, covering about 7 square miles, is about $250 per square mile. This work is seldom quoted on a square mile basis, but rather on a lump sum for the completed job.

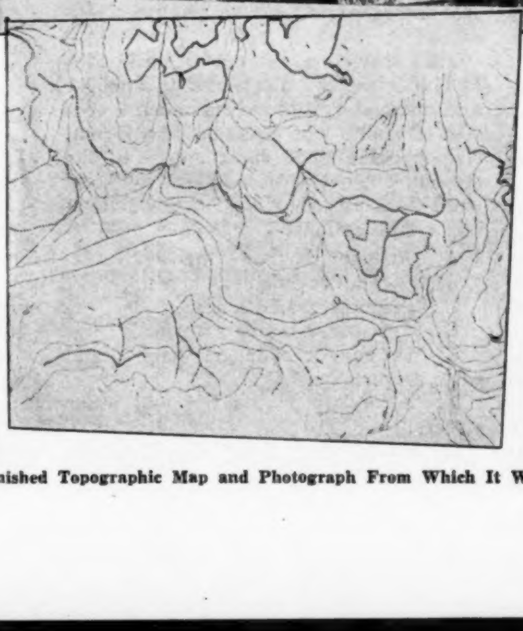


Fig. 5—Finished Topographic Map and Photograph From Which It Was Constructed

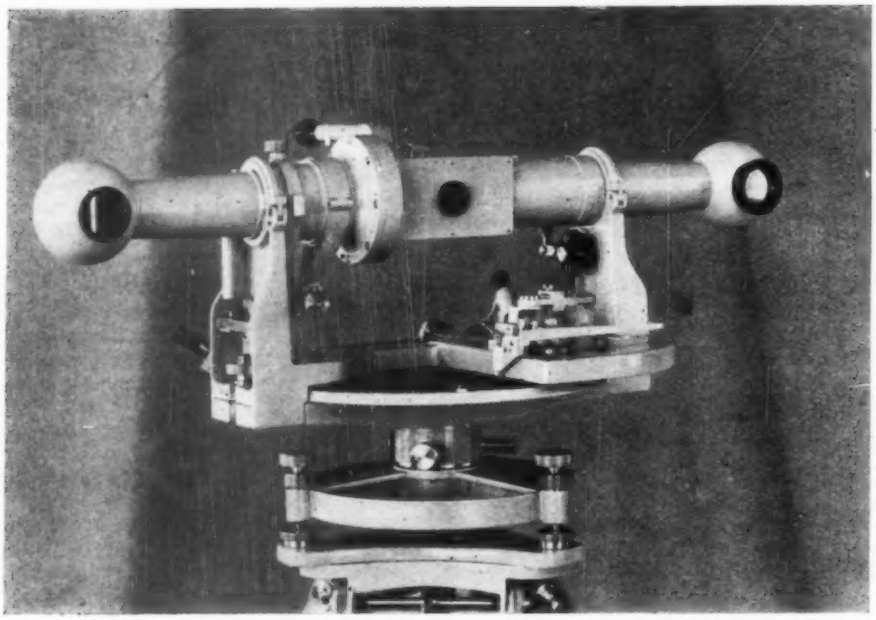


Fig. 6—The Stereo-Autotachgraph—A Combined Finder, Stereoscope and Plane Table

Undoubtedly with the expected improvements in the field and office methods, good mosaics should be able to be made for a small fraction of the cost of a topographic map by the usual ground methods. It is also expected that topographic mapping of large areas on scales comparable to those used by the Geological Survey, as well as topographic maps of smaller areas on larger scales, in difficult and inaccessible territory, will be made in less time, more accurately and cheaper than by the standard ground methods. The important consideration is that any proper use of aerial photography will show the minor details of the photography better than can be accomplished by the usual ground survey methods.

In appraising the value of aerial maps, it should be considered that maps ordered by a highway department may also be used for many other public improvements, such as pipe and transmission lines, city, town and regional planning boards, as well as assessment boards. They will be of value for real estate developments, court cases and other purposes.

Acknowledgment—The above is a paper presented at the 6th Annual Convention of the Association of Highway Officials of the North Atlantic States.

Making a Definite Progressive Plan of Street Lighting

WHAT was accomplished by one city in laying out a definite, progressive street lighting program, in which each year's improvements are scheduled ahead, was described by Dudley M. Diggs of the lighting section of the General Electric Co. in a paper presented June 11 at the New York State Conference of Mayors and Other Municipal Officials. The following is extracted from his paper:

Until quite recently the street lighting of Schenectady, N. Y., like that of many other cities, grew in a haphazard way—a little here and a little there. One night experiments were conducted on some of the Schenectady streets. These experiments proved that the officials had been laboring under the impression that if certain streets were dimly lighted, headlights would make up for this deficiency in safety to pedestrians who might be passing on the streets. It was found that this idea was erroneous and that these streets were actually dangerous and a menace at night, due to the poor illumination.

This started a survey with the idea of laying out the whole city in a proper and adequately lighted manner.

A city map was obtained of sufficient size to get a good visualization of the streets. All the streets in the city were then placed in one of the following classifications:

A. Primary business streets.
B. Secondary business streets.
C. Primary traffic arteries.
D. Secondary traffic arteries.
E. Primary residential streets and park drives.
F. Secondary residential and other streets.

In determining these classifications the greatest weight was given to the probable importance and conditions of a street five years hence rather than at the time the survey was made. In order to easily and quickly visualize the whole city, red was used for the primary business streets, yellow for the secondary business streets, green for the primary traffic arteries, purple for the secondary traffic arteries, brown for the primary residential streets and park drives, whereas the secondary residential and other streets were left in white (this map being a white print with blue lines). The proper illumination for each street, mounting height, spacing, lumens per linear foot, type of standard and fixture, etc., were then decided upon. This was incorporated in a tabulation on the face of the map.

This survey then gave a concrete proposition to present to the finance committee and other proper city officials.

The worst lighted streets were scheduled for correction the first year. The rest of the improvements, in relation to their urgency, was divided up for the next four years, and each one laid out in advance.

Another map of the city was then taken and filled in to show what might be termed a "progress" map. Those streets which seemed to be more nearly adequately lighted at the present time were shown in solid red. To this was added by a red dotted line the streets which were most urgently in need of being brought up-to-date, and this was captioned in the tabulation, "Previous and 1929 Installations." Those streets scheduled for installation in 1930 were shown in green, those for 1931 in yellow, those for 1932 in purple, and those for 1933 in brown. Here again a concrete presentation could be made to the finance committee, Chamber of Commerce, City Council and others interested, in such a manner that they could quickly grasp the whole program. The survey gave a definite improvement program, the cost of which could be determined beforehand. This, therefore, made it easier to include in the budget. The latter is a very important point.

The tendency of some cities has been to go on from year to year appropriating the same amount for street lighting. With a definite program before them, the city council sees the logic of the increase in the appropriation for street lighting each year. This does away with possible misunderstandings over the amount to be spent each year.

The city profits by having the maximum efficiency from every light in town. This is due to the fact that every light is specially adapted for the place where it is used, and every unit is in its correct place. The city is buying "seeing ability on its street," and this is what it is really paying for. With such a definite progressive program the city receives the maximum results for the money expended.

Engineering Control in Municipal Improvements

An Interesting Discussion of the Various Problems Relating to Physical Improvements in a Small City

By C. B. CARPENTER
City Engineer, Bloomington, Ind.

THE success of a city engineer's work is certainly dependent upon rather versatile ability. He acquires, not of his choice, for solution a grotesque mixture of materials and conditions and against indescribable obstacles accomplishes only in part results in absolute keeping with his desires. Antiquated customs are oftentimes a hazard to his foresight. In order to accomplish results coinciding with his conscientious beliefs, he must constantly practice diplomacy as well as tactful salesmanship. Likewise the success of his relations with the public is dependent to some degree upon his ability of being able to assure that his work is in keeping with the best practice elsewhere.

Two Classes of Engineers.—There are two classes of engineers interested in public work, or for that matter, any type of engineering work. There is first a group which follows custom without deviation. The second group represents a class which ventures into the field of the experimental. Both classes are necessary for a successful continuance of the profession, for upon custom rests the confidence the layman has in the engineer and experiment must provide for advances in thought and practice.

The field of highway engineering provides an example of interest in the foregoing. The individual who follows pavement construction as a means of livelihood or from general interest cannot help being impressed by the gigantic proportions the industry is assuming year by year. Experiments and the establishment of customs by the federal and state groups are of great value to municipal engineers for adoptions, with variations perhaps in establishing the confidence of the layman, a confidence which is important.

A comparatively short time ago, the performance of a public improvement contract invariably consisted of a battle of wits between the contractor and the engineer, with the contractor at an advantage, because of his superior number of representatives on the job. While the same may be true to some extent even today, it seemingly is not general.

First Cost and Ultimate Economy.—From observations, it would seem that the general public is demanding a different quality of public work than was formerly the case. It would seem likewise that ultimate economy is taking precedence over first cost; that the public is beginning to recognize the fallacy that cheapness necessarily implies economy. Notwithstanding what has just been said, the public is mindful of ultimate costs. The public works engineer has been obliged, therefore, to acquaint himself with designs and methods involving the greatest returns for an amount of money spent. His specifications are tending more and more to become a useful tool instead of a necessary evil in construction operation.

To the layman the subject of specifications, including their enforcement, in construction procedure, is a simple one. He will wave aside all possible difficulties with the phrase, "Well, that should be easy, see that the contractor builds in accordance with the plans and specifications," an expression which in itself is boresome, to say the least, to all of us.

Importance of Specifications.—It is true that the part played by some specifications with relation to construction work, in the past and at present, is capable of much criticism. We can readily acknowledge that a good specification does not necessarily imply a good product, but conversely, a good product seldom results from the use of a poor specification. Plans without specifications may mean nothing in that they merely picture the physical appearance of the finished structure with nothing to give it life and quality. The specification should be the keynote of the whole construction operation. By it the contractor should be guided in assembling the parts which make up the completed whole, and the engineer should be enabled to assure himself as the various operations are performed, that the finished structure will conform to the requirements of the contract.

It is obvious then that if specifications are the backbone of the construction operation, they should express the requirement which if fully complied with will result in as perfect a structure as present day knowledge will allow.

Assuming that the specifications are ample, which is a large assumption, the question of "fully complied with" is the real subject in which we are interested. Strange as it would sound to the general public, there is great reason to believe that the actual number of public works engineers who know that the requirements of specifications have been correctly interpreted and carried out, are in the minority.

Any attempt to analyze the cause for such a condition readily discloses innumerable factors. A phase of practical solution invariably evolves about one factor; namely, the education of all individuals affected or connected with public improvement expenditure: the taxpayer, the contractor, and city officials. In many instances the individuals serving in a supervisory capacity upon public improvement construction are men appointed directly by the governmental body empowered to carry on such work. They are in those instances men whose experience has been in a line of endeavor more or less foreign to construction work. Their eligibility is too often based upon reasons other than competence or ability.

The position of the city engineer under such a system of inspection is a peculiar one. If his program is large and involves several contracts at one time, he is at best extremely handicapped in obtaining the class of work anticipated by his conscientiously prepared plans and specifications. Actually he is responsible to the public and his governmental officers for results beyond his control.

It is hardly to be regarded as strange, therefore, that a city engineer working in connection with such a system should seek a solution in part at least for more complete execution of the work in his responsibility.

Early in 1926 after considerable deliberation and with some slight misgivings our engineering department was given the authority and the charge of being directly responsible for all public improvement inspection and supervision. That year an inspection department was organized upon a small scale capable of being later enlarged upon the same general basis.

As part of that organization, two ideas were paramount: first, that the engineering department be absolutely responsible and without alibi for all work performed; second, that the cooperation of the contractor demanded the department's cooperation.

The reaction of the contractors generally amounted briefly to an extreme willingness to cooperate. They were able to foresee the advantage of placing their work upon a higher plane with the consequent effect of stabiiization as a local industry.

Selection of Inspectors.—Selection of inspectors and supervisors was and is a great problem. The basis of selection has been that an individual should have as nearly as possible an appreciation for and a knowledge of the various phases related especially to construction work of a public nature.

As is indicated, our aims as to the type of individual are very high. An

attempt has been made to pick, when possible, men with a particular ability based primarily upon authoritative recommendation. It has been intended likewise to select men who are above all things honest and of good character, otherwise the interests of all parties would be jeopardized. It has been the belief also that each individual should be interested in his work. In brief explanation, there has been involved a thing of mutual interest. We have attempted when possible to offer the individual an ideal, appealing to his sense of obligation to his work, for which he can conscientiously reciprocate by a form of zealous interest. When feasible and conditions have permitted, he has had almost from the start a responsibility which has increased with his proved ability. The fellows in some instances have shown particular aptness in special phases, in which events they were given encouragement for increased development. The whole idea is based somewhat upon the assumption that the organization is effective only to the degree in which the members are interested.

It has been found of great assistance for a better understanding and appreciation to have regular meetings attended by all inspectors and supervisors. At these meetings, the various details related to the work have been reviewed and discussed. New ideas have been encouraged as much as possible. Every attempt has been made to impress as well as to create an appreciation of the specification intent.

As a particular aid in effecting understanding and cooperation, meetings between the city engineer and the contractor organizations have been especially helpful. There have also been instances concerning questions of general interest where both the inspectors and the contractors were brought together. These last meetings refer particularly to instances where there were new changes in specifications with reference to previous work. Discussion by the two groups permitted of a more exacting understanding. Similar meetings held as the work progressed and new problems and situations arose proved of practical worth likewise.

One of the particular duties of the inspection department is that of making a record of each and every operation entering into the various details of the work. Such records are kept upon standard forms and are regarded as a vital part of the work.

Inspection work is divided into three major classifications:

1. Highways
2. Sewerage
3. Structures.

Concrete Inspection.—Because of the fact that a large portion of the work during the last few years has been in connection with the use of concrete, a general outline of the method of concrete inspection, especially concrete pavements, might be of interest.

Crushed limestone has been used almost entirely as a coarse aggregate. For practical purposes, there are six distinct local formations which by visual inspection may be readily rejected. The acceptability of remaining formations are subject to physical and chemical examination by ledges and general location in the quarry. Depending upon the uniformity of the ledges, this is a constant problem. There have been instances where tests indicated results contrary to actual knowledge though such instances have been few. The success of our local stone as a coarse aggregate for concrete in my opinion is dependent upon the ability of local operators to produce a material uniform as to quality and gradation. The use of local stone as an aggregate requires constant vigilance, and although there has been much improvement in the past few years in producing suitable stone, there remains a considerable amount of work to be done before our part ceases to be a strenuous one.

Unfortunately, there is no sand within the radius of several miles which may be used for concrete aggregate. Our sand is examined and inspected upon delivery usually and only occasionally at the plant. It is intended to obtain a sample of every car, which is in itself a laborious process. Samples representative of a shipment are examined for silt, organic matter, and gradation. Mechanical analysis is made upon representative shipments in an attempt to control gradation.

Bin tests at the mill through a commercial laboratory have been used for cement inspection.

In connection with the job end of a concrete operation, the entire improvement, including necessary construction survey work, is in charge of a job supervisor responsible only to the city engineer. Assisting the job supervisor and responsible directly to him is a cement checker and a plant inspector. In the event more than one contractor organization is operating from the same material plant, the plant inspector is responsible to the city engineer directly. During the operation of placing concrete for pavement, communication is established between both ends

(PINK)

FILE NO. A-162 — DAILY CONSTRUCTION REPORT — SHEET NO. 26

DATE OF LAST REPORT JUNE 21, 1929 — HIGHWAYS, OFFICE OF CITY CIVIL ENGINEER, BLOOMINGTON, INDIANA — JOB NO. A-162

DATE JUNE 22 1929

1—CONTRACTOR JOHN B. MITCHELL 2—IMPROVEMENT N. EUCLID AVE.

3—WEATHER FAIR + WARM TEMP. ____ MAX. TIME ____ MIN. TIME ____ (TO BE FILLED OUT WHEN BELOW 40° F OR ABOVE 80° F)

4—LOCATION OF DAYS WORK BY STATION E. SIDE 0+00 TO 5+83.3

5—CHARACTER AND PREPARATION OF SUB-GRADE FOR THIS DAYS WORK WELL ROLLED BUT DUSTY NECESSARY TO SPRINKLE BEFORE POURING

6—DESCRIPTION OF DAYS WORK PLACED PAVEMENT ALL DAY

		SACKS CEMENT FACTOR CEMENT	USED	REQUIRED	PERCENTAGE SHORT	PERCENTAGE SURP.
A—LIN. FT. COMB. CURB & GUTTER ____	TOP					
	BASE					
B—LIN. FT. RADIUS CURB ____ OF ____ FT. R.	TOP					
LIN. FT. RADIUS CURB ____ OF ____ FT. R.	BASE					
	TOP					
C—LIN. FT. RADIUS CURB ____ OF ____ FT. R.	BASE					
33.14 SQ YDS	~~TOP~~					
~~D—SQ. FT. SIDEWALK~~ 16TH ST. INTERSECTION	~~BASE~~	1.35		44.74		
E—LIN. FT. PAVEMENT 583.3		2.025		1181.18		
F—TOTAL QUANTITIES OF CEMENT FOR THE DAY			1236	1225.92		.82%

SLAB WIDTH 13½' THICKNESS 7"

G—BATCH METER READING END OF DAY 72946

BATCH METER READING BEGINNING OF DAY 72740

G—NO. BATCHES FOR DAY 206

REMARKS:

H—LOCATION OF ABOVE STRUCTURES —A-B-C-D-E— BY STA. AND INTERSECTION ETC. SEE #4 ABOVE

I—R. P. M. OF DRUM THREE READINGS			REV. PER BATCH THREE READINGS	SIZE OF BATCH	SLUMP					
18	18	18	—	6 BAG	2½"	3"	2½"	2½"	3"	3"

J—AGGREGATE, IF ANY CHANGE FROM GENERAL REPORT NO CHANGE

K—WHAT DAYS WORK BEING CURED—DATES—FROM JUNE 20 TO JUNE 22 METHOD CALCIUM CHLORIDE WETTED BURLAP USED ON THIS DAYS RUN

L—CONTRACTOR BEGAN WORK AT 6:30 AM STOPPED ~~AT~~ POURING 5:30 PM FINISHING 7:30 PM

M—FOREMAN IN CHARGE JAMES HENRY

N—BRIEF REPORT OF WORKMANSHIP FOR THE DAY FAIR - DELAYED BY FAILURE OF STONE CRUSHER TO KEEP UP WITH MIXER

F. J. [illegible]
INSPECTOR

—USE REVERSE SIDE FOR REMARKS—

• SEE REVERSE SIDE FOR SKETCH OF 16TH ST. INTERSECTION

Fig. 1—Report Form Used in Connection with Street Improvement

of the work and an attempt is made to promptly correct material quantities.

During the progress of the work, every effort is made to take advantage of reasonable practice for obtaining maximum results as to quality of pavement. For reasons of design as well as to provide for a greater ease in finishing operations, especially upon the steeper gradients, of which there are many, street pavements are built in at least two longitudinal sections. It is intended now that such widths shall not exceed 14 ft. Tongue and groove longitudinal joints are obtained with special forms. Scratch templates are used for obtaining subgrade depth and especial attention is given to subgrade preparation and maintenance. It is believed that not enough attention can be given to our particular subsoil and soil condition.

Water control is in our opinion more important than any other single item entering into the concrete operation. An attempt is made at all times to insure first of all a workable concrete. For finishing machine work, a slump of 1 to 2 in. is used and for hand finish 3 to 4 in.

A method of hand finishing which produces results comparable to machine finishing has been used. It is relatively easy for the finishers. Its practicability has been dependent upon a definite sequence of operations, each outlined by number and after a short time made routine. It incidentally includes at least three straight edge checks.

Included in the finishing operations and related to curing is the process of removing such laitance as appears upon the pavement surface, previous to the final belting. We believe this very important in effecting structural unity of the slab.

Great stress is laid upon both initial and final curing. Immediately behind the final belting or just as soon as the surface will permit, wetted burlap is placed and kept wet until the final cure is started. Calcium chloride has been generally used as a final curing agent. Distribution as to method and amount is supervised in a painstaking manner.

High spots in excess of ¼ in. in 10 ft. are removed early upon the day after placing concrete.

Reports.—At the end of each day, the job inspector's report, including the report of his assistants, is received at the engineer's office, and briefly examined and checked not later than early the next morning. It is intended that repetition of possible deficiencies or questionable factors possibly having occurred upon the previous day be eliminated at once. It should be mentioned incidentally that cement yields are checked periodically during the day.

The job supervisor's daily report carrying a brief summary of his assistants' reports, is intended to give a brief review of all activities of the day. It is intended likewise that a complete set of such reports along with concrete test reports be actually an authentic history of the work for future reference.

Concrete curb and gutter and walk are handled virtually in the same manner as described above for pavement, excepting for contractor organizations. As mentioned above, every effort is made to produce workable concrete first of all and to see that the materials and operation entering into the product are in keeping with the standards of good concrete. Incidentally every effort is made in such class of work to check for cement in accordance with predetermined factors.

The report form (Fig. 1) is used in connection with street improvement work. It has been found especially helpful in making up final reports upon the entire job to use the three colored sheets, one color for each type of structure. White has referred to a general report, yellow to curb and walk, and pink to pavement.

A special form is used with reference to structural concrete in its various classes. The intent has been for the same method of control as has applied to the concrete mentioned heretofore.

General sewer construction work has been with a few exceptions handled under a separate department of inspection It is further divided into material inspection and supervision of construction.

All factory made pipe is inspected at the car and the variations allowed by A. S. T. M. specifications are adhered to. As a general rule, sewer construction supervisors have been made to qualify as material inspectors before being placed in charge of the construction work. The pipe examined at the car is likewise inspected upon the job just previous to placing.

Field constructed concrete pipe is controlled by the methods mentioned in connection with concrete inspection. With this type of pipe, a separate material report is kept along with the sewer construction report.

In connection with the general system of inspection and supervision mentioned herein, it is not intended to express the belief that an even partial cure-all for the common ailments of small city construction has been effected. Likewise it is not the intention to flatter ourselves into believing that our work is without criticism. The way ahead for such an attainment is a long route. The principal satisfaction enjoyed, however, is that of establishing a new local custom of practical worth. If we are permitted to enlarge upon the idea from year to year, it will be possible in time for the quality of our work to keep astride of, rather than attempt to follow, the best results attained elsewhere.

Acknowledgment.—The foregoing is a paper presented at the 16th annual Purdue Road School.

1931 A. R. B. A. Convention and Road Show to Be Held in St. Louis

St. Louis has been chosen for the 1931 convention and road show of the American Road Builders' Association. The Missouri metropolis was selected over the rival bids of Houston, New Orleans, and other cities of that region, because of what are thought to be superior facilities for accommodating the delegates and the exposition of road machinery and equipment.

Another strong point in favor of St. Louis is its location in the very center of the midwestern and southwestern area, among the states that have the largest road building programs of the entire nation under way. A railroad center, St. Louis will be easily accessible to manufacturers, the majority of whom come from east of the Mississippi river, and to delegates and road building engineers who will attend from the entire country.

Meeting for the first time in more than a decade in a Southern city, the convention will undoubtedly attract the largest representation in history of contractors, engineers and highway officials from not only the states which are far advanced with huge expenditures of funds for comprehensive road programs but from others of the Southern states which have lagged behind in the highway industry because of financial reasons and possibly a lack of thorough appreciation of what road building means in upbuilding of local resources and community life.

Those who sought the convention and road show for Houston have announced that they will redouble their efforts to secure the 1932 meeting, and it is thought that the association officials might welcome the opportunity to continue its traveling policy by going into another section of the South a year after the St. Louis meeting.

The executive committee of the association is convinced of thoroughly adequate hotel accommodations for all who may attend the St. Louis meeting, and they have been impressed with the commodious facilities for the convention meetings and for the Road Show exhibits offered by the Highlands Arena.

The main arena and two adjoining exhibition buildings provide 247,800 sq. ft. of floor space for exhibit purposes, and a structure will be erected this year to house convention sessions.

Already requests for information regarding the 1931 road show have begun to come into association headquarters and officials are very optimistic regarding the results of the St. Louis meeting.

Traffic Accident Statistics

Findings and Recommendations of the Committee of the National Conference on Street and Highway Safety

STATES with complete systems for licensing motor vehicle operators and administering traffic laws are showing the lowest accident death rate from traffic causes of any part of the United States, according to the findings of the Committee on Traffic Accident Statistics of the National Conference on Street and Highway Safety. Findings and recommendations of the committee are given in its report, submitted to the third National Conference on Street and Highway Safety, held in Washington on May 27, 28 and 29. The report is signed by Dr. Julius H. Parmelee, Director of the Bureau of Railway Economics, as chairman of the committee.

8.2 Per Cent Increase in Traffic Fatalities in 1929.—The committee finds that in the sections of the country without drivers' licensing systems the traffic death rate increased more than twice as rapidly from 1920 to 1928 as it did in the areas with the licensing systems.

Street and highway traffic accidents in the United States last year claimed the lives of 33,060 persons, of whom 31,000 were motor vehicle fatalities, according to the findings of the committee.

This was at the rate of one traffic death each 16 minutes during the year.

The total number of persons injured in traffic accidents in 1929 is estimated by the committee at 1,200,000, of which 1,000,000 were hurt by motor vehicles.

Total traffic fatalities, covering all classes of street and highway accidents, are found by the committee to have increased last year by 2,513, or 8.2 per cent, over 1928. The increase in fatalities due directly to motor vehicles in the same time was 10.8 per cent over 1928, or 147 per cent over the number of fatalities in 1920.

The committee does not attempt to estimate the economic waste and loss resulting from motor vehicle accidents, but offers the finding of the National Safety Council on this point, as follows:

"The economic costs of motor vehicle traffic accidents continue to rise along with the number of deaths and injuries. These costs are now approximately $350,000,000 greater annually than in 1923. The estimate for 1929 is $850,000,000, compared with $500,000,000 estimated for 1923 by the first National Conference on Street and Highway Safety. The conference estimated $600,000,000 for all traffic accidents, of which approximately $500,000,000 could be charged to motor vehicles alone. A billion dollars of waste every year from motor vehicle accidents will soon become a reality unless something is done to check the increase."

The summary of the findings and recommendations of the committee follows:

Statistics on Accidents.—Aggregate loss of life due to street and highway accidents in the United States during the year 1929 totaled 33,060 persons. This was an increase of 2,513 traffic fatalities, or 8.2 per cent, over the previous year, and an increase of 16,005 fatalities, or 94 per cent, over 1920. Every year of the period from 1920 to 1929, inclusive, showed an increase in traffic fatalities over the next preceding year.

The traffic fatality rate per 100,000 population rose steadily from 16.0 in 1920 to 27.2 in 1929.

Motor vehicle fatalities in the United States in 1929 numbered 31,000, which is 93.8 per cent of the total number of traffic fatalities. This was an increase of 10.8 per cent over 1928. The increase from 1928 to 1929 was one of the largest increases, both absolutely and relatively, that has occurred during the past decade. Motor vehicle fatalities showed an increase from 1920 to 1929 of 147 per cent.

Returns for the first four months of 1930 show no improvement. In fact, statistics indicate an even greater rate of increase over 1929 than 1929 showed over 1928. Clearly, the problem is not only serious, but is growing more serious each year.

Accident Increase Exceeds Automobile Registration.—In 1927, for the first time since statistics have been compiled, the relative increase in motor vehicle fatalities over the next preceding year exceeded the relative increase in number of automobiles registered. The same was true of 1928, and was again true of 1929. For three years past, therefore, the number of fatalities has been mounting at a faster rate than the number of cars.

Whether this recent tendency is due to a more intensive utilization of the average automobile, or to the greater speeds at which now driven, or to a generally more reckless disregard of traffic and safety rules, or to all three factors combined, it is difficult to say. These factors, and others, doubtless play their part, and must be taken into account as significant elements in the problem.

Railway Grade Crossing Accidents.—Fatalities due to railway grade crossing accidents increased from 1,791 in 1920 to 2,485 in 1929, or 38.7 per cent. There was a decrease of 3 per cent between 1928 and 1929. During the past seven years, or from 1923 to 1929, grade crossing fatalities have remained relatively constant, ranging between a minimum of 2,149 in 1924 and a maximum of 2,568 in 1928. During the same period, from 1923 to 1929, the number of motor vehicles registered in the United States increased from 15,092,000 to 26,501,000, or 76 per cent.

The ratio of grade crossing fatalities to total traffic fatalities showed a generally downward tendency from 1920 to 1929, the percentage being 10.5 per cent in 1920 and 7.5 per cent in 1929.

Fatalities due to street car accidents showed a gradually downward tendency from 1920 to 1929, the total number being reduced from 2,124 to 1,600. The ratio to total traffic fatalities declined at a more rapid rate, from a maximum of 12.5 per cent in 1920 to a minimum of 4.8 per cent in 1929.

"Other vehicle" fatalities also showed a large decline during the period from 1920 to 1929, both in absolute number and in relation to total traffic fatalities.

The outstanding factor in the alarming growth of the traffic accident problem is the development of the motor vehicle and its more intensive and extensive utilization.

Accidental deaths in the United States from all causes totaled 97,000 in 1929, an increase of 27.6 per cent over 1920. Motor vehicle fatalities accounted for 16.5 per cent of total accidental deaths in 1920 and 32.0 per cent in 1929. In other words, one out of every three accidental fatalities in 1929 was due directly or indirectly to automobile operation, compared with one out of six fatalities in 1920.

The accident rate of motor vehicle fatalities increased from 11.9 per 110,000 population in 1929 to 25.6 per 100,000 in 1929. The fatality rate from all other accidental causes declined from 59.5 per 100,000 population in 1920 to 54.4 per 100,000 in 1929.

The increase in child fatalities from motor vehicle accidents has been less than in adult fatalities from the same cause. Between 1922 and 1928 total motor vehicle fatalities increased 82.2 per cent; but child fatalities (under 15 years of age) increased only 22.9 per cent, while adult fatalities (over 15 years of age) increased 106.9 per cent.

Causes of Motor Vehicle Fatalities.—In 1929, approximately 55 per cent of motor vehicle fatalities were due to collisions of the motor vehicle with pedestrians, while collisions between two or more motor vehicles accounted for about 19 per cent. These two principal causes of accidents were responsible for about 74 per cent, or nearly three-fourths, of the total, and focus attention on this phase of the problem.

Statistics further indicate that more than 50 per cent of the accidents occur at street intersections, thus supplying

a clue as to where safety activities should be centered. With regard to the circumstances of pedestrian-motor vehicle accidents, "crossing the street at intersections" is the most productive cause of death, "crossing the street between intersections" ranks second, while "at play in the street" ranks third.

Motor vehicle drivers "not having the right of way" are charged with the greatest number of casualties in 1929, but resulted in fewer deaths than either "drove off roadway" or "exceeding the speed limit," which ranks in that order in the number of deaths. "Driving on the wrong side of the road," "cutting in" and "failed to signal" are other important causes of casualties attributable to drivers of motor vehicles.

Effect of Licensing Drivers.—There is important evidence of relatively better accident records in states which have the more complete systems for licensing motor vehicle operators and administering the traffic law. Comparison of the rates of increase in automobile fatalities and registrations, respectively, between 1920 and 1928 by groups of states show that in the groups with strong centralized state motor vehicle administration and drivers' license systems with mandatory examination the rate of fatality increase has been less than that of registrations, whereas in the other groups fatalities have greatly outrun motor vehicles in use. In the North Atlantic states fatalities increased by 91 per cent between 1920 and 1928, while registrations increased by 192 per cent; in the Middle West fatalities by 161 per cent and registrations by 146 per cent; in the South fatalities by 286 per cent and registrations by 224 per cent. The records of the Pacific Coast and Mountain States were intermediate between those of the North Atlantic and Middle West. Separate comparison for 1920-1924 and 1924-1928, respectively, shows similar relationships among the several groups of states, with the 1924-1928 period presenting in each case a less favorable record than that of 1920-1924.

Fatalities Reduced in Cities.—There are encouraging indications of a reduction in the number of automobile fatalities in some of the larger cities. Of the 78 cities of more than 100,000 population for which comparable information is supplied by the Department of Commerce, 24 reported a decrease from 1928 to 1929 in the number of automobile fatalities; in four cities the number remained stationary.

Another hopeful sign was the progressive reduction in a few cities. Four of the principal cities showed reductions in automobile fatalities in both 1928 and 1929, while two of these cities reported reductions of 10 per cent or more in both years.

Safety Education.—The committee strongly urges that emphasis be given to safety education in the schools. Fatalities to children under 15 years of age in traffic accidents should receive the serious consideration of the school authorities in every community, with a view to augmenting instruction in safety methods and accident prevention in the schools, and reducing this annual toll to the lowest possible minimum. School authorities should join with police officials in providing for the safety of children, and compelling compliance with traffic regulations in the vicinity of school buildings.

Safety education is assuming a more important place in community life and is one of the definite means through which a reduction in the accident toll may be brought about in the future.

Traffic Accident Reports.—Where they do not now exist, statutes should be passed in every state which would make it the specific business of some state agency, preferably that clothed with authority for issuing or revoking licenses, to receive traffic accident reports and to investigate accidents, whether occurring within or without the corporate limits of municipalities.

It should be made obligatory by law for those concerned to report traffic accidents, and an adequate penalty for failure to report should be provided.

Reasonable uniformity in reporting and tabulating schedules is essential. Standard definitions of terms should be generally adopted and used.

Sufficiently detailed information should be gathered to indicate clearly the circumstances surrounding the accident, as follows:

(a) Recklessness, carelessness or incapacity of persons;
(b) Fault of mechanism of the vehicle;
(c) Physical conditions of the locality where the accident occurred.

Accident spot maps or card files should be maintained, to be used primarily to detect points at which accidents occur most frequently, and as a basis for plans to eliminate the conditions which may lead to accidents.

Safety Movement Has Made Progress.—The committee feels justified in the conclusion that the safety movement and safety education have made some progress in the traffic field. Accident reduction in some cities shows it. The saving in child life emphasizes it. The causes for congratulation are far outweighed, however, by the distressing general increase in traffic fatalities as a whole. The number and rate of fatalities should be reduced, instead of showing steady increase year after year.

Statistics are increasingly available, on the basis of which to diagnose this social ill and point the way to effective remedies. These remedies must be applied, and this appalling and wholly needless loss of human life can and must be checked.

Nearly 1,200,000 Non-Fatal Injuries in 1929.—In the discussion of non-fatal injuries, the committee says:

It is reliably estimated that no less than 35 reportable non-fatal injuries occur for every one fatality. If this ratio be correct, and the committee offers it as a reasonable basis, then the non-fatal injuries from all traffic accidents in 1929 totaled near 1,200,000. If the same ratio applies in the case of motor vehicle accidents of all types, approximately 1,000,000 persons were injured in motor vehicle accidents in the United States during 1929.

The committee points out that in 1920, 136 persons met death in motor vehicle accidents of all kinds for every 100,000 automobiles registered. This ratio declined steadily to 1926, when it was down to 107. In 1927 it turned upward to 112, and rose again in 1928 to 114. The committee's estimate for 1929 is 117 deaths per 100,000 automobile registrations.

Fatalities caused by vehicles other than automobiles appear to the committee to be on the decline, and the major problem in street and highway safety work is declared to revolve around the automobile.

Fatality Rate Doubles.—The committee says:

Between 1920 and 1929 the fatality rate from motor vehicle accidents per 100,000 population more than doubled, being 11.9 in 1920, and 25.6 in 1929. In other words, two fatalities occurred in 1929 where only one occurred in 1920. Stated in somewhat different terms, the death hazard to the average citizen from motor vehicle operation in general was doubled during this period.

Adults of 55 years or more were involved to the greatest degree in pedestrian accidents, their proportion being 35 per cent, contrasted with a corresponding percentage of 25.4 per cent for all accidents. For all types of accidents, children were involved in 21.3 per cent, or about one-fifth. They were involved, however, in 30.8 per cent of pedestrian accidents.

In discussing accident prevention and investigation, the committee says:

"In a growing number of cities it has been found practible and desirable to provide a special accident investigation bureau or squad in the police department, for the purpose of visiting immediately the scene of every important street accidents, taking photographs and exact measurements of the position and course of the vehicles, and noting any other conditions having a bearing on the matter, as well as getting complete accounts of the accident from all witnesses.

"Where such evidence indicates a violation of law by one or more of the parties involved, they are arrested and often convicted in cases where, without such special investigation, conviction would have been impossible and even arrest might have seemed unjustified. Such accident investigation squads are now at work in a number of cities.

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Is Commercialism Degrading to Pure Science?

"Here's to pure mathematics; may it never be of any use to anybody!" This ancient toast to an ancient science has caused many a smile, particularly among practical men, but it voices a not uncommon feeling among scientists. Science solely for science's sake has always appealed to many a man, yet rarely has a great scientist failed to praise science because of its practical utility. Indeed it has seemed to us that much more has been written by scientists about the economic value of science than about the pleasure afforded by the contemplation of its truths, or even by search for its laws. And why not?

During many generations many writers have spoken of commercialism with an accent akin to a sneer; the same types of writers have extolled pure science because of its freedom from the "taint of commercialism." But is such an attitude defensible? One of the greatest of pure scientists, Herbert Spencer, the philosopher of evolution, in an essay on education pointed out that the two most important things that should be taught are (1) how to preserve one's health and (2) how to earn a livelihood. Since commercialism involves the earning of livelihoods, Spencer evidently held it in high esteem. Nevertheless, it can not be denied that pure scientists have commonly regarded business economics as a branch of human activity far beneath pure science. We think we see the beginning of a change in this attitude. Among the straws that show which way the wind is veering may be mentioned the recent announcement of the University of Michigan that profits from discoveries made in its research laboratories will be devoted to further research. Here is frank recognition of the usefulness of commercialism, if it be only in financing scientific research. Of course many a research laboratory has been financed by gifts from men who had made fortunes commercially, the Rockefeller gifts being among the largest and most fruitful of this kind. Also the research laboratories of several of our great manufacturing companies have become noted for their discoveries in the realm of what is termed pure science. But when an educational corporation announces its intention of commercializing its scientific discoveries, the editors of the metropolitan papers at once sense a relatively new thing. Forthwith some of them begin to apologize for such "commercializing of pure science." One of the great newspapers says:

"The danger of any such arrangement, of course, is that research will be diverted from its true end, the search for the new and interesting, for genuine additions to knowledge, to a search merely for what is profitable. The latter sort of search usually neither adds anything to knowledge nor has profitable results. Profit comes most frequently as a mere by-product. But a research laboratory which keeps this firmly in mind need not be ashamed of turning the by-product to its own use."

We see in this quotation the age long sneer against profit making, in the words "merely for what is profitable." There is a fallacy at the bottom of all such belittling expressions about profit making. Probably it has its origin in the belief that "money makes money," and that an automatic accumulation of wealth thus occurs, which is the origin of practically all profits. The truth is that it is only brains and energy that ordinarily produce profits, and that the interest that money receives is primarily but a rental for the use of capital, which rental comes out of profits made by brain power. Furthermore, under competitive conditions, it is only highly efficient executives, inventors and engineers who are able to produce profits over a period of years. Business profits are then primarily a reward for mental efficiency, part of which reward is shared, in the form of interest and dividends, with the capitalists who finance enterprises.

It is becoming more and more clearly recognized that increased knowledge of the laws of nature enables inventors and engineers to produce profits where nothing but losses would exist without such knowledge. Pure science is thus seen to be the best servitor of profit making enterprises. Does any degredation come to pure science as a result of such service? If there is any degradation it must be because the service is one that is injurious to humanity. Who dares assert that Edison's use of the scientific discoveries of Faraday has been injurious to humanity? Who will say that the fortune that Edison has reaped from his inventions was not a very small reward for his very great gifts of cheap light, the delightful music of the phonograph and the entrancing moving visions on the "silver screen"?

We confess to growing impatience over the slurs at profit making that so many writers are accustomed to make. We notice that they never regard the profits from ther own writings as being reprehensible rewards for entertaining the public; yet somehow the profits that accrue in the process of serving humanity by applying science in manufacturing—well, that, in their sight, is a different and a reprehensible thing! There have been many writers of the H. G. Wells type who,

having never essayed to run any business, think that "money makes money" very much as clouds make rain, because it is inevitable. Let such a professional writer be asked to pit his skill at golf against a Bobby Jones, and he will decline precipitously, especially if a wager be involved. The golfing skill of Bobby Jones is at least no greater than the business skill of Carnegie or the combined inventive and business skill of Ford. It is only the business ignorance of Wells and other writers that prevents their recognizing the true causes of business success. Unfortunately most of the writers of fiction, of magazine essays and of those daily paper essays called "editorials," are economic illiterates, however literate they may be otherwise. And since their writings have been most widely read, it is to be expected that it will be many years before it will be generally appreciated that the great object of all scientific research should be to enable inventors, engineers and business men to produce better, cheaper and more varied goods and service.

There is no more merit in pure science without an eventual application in the service of humanity than there is in the speculations of a Buddhist philosopher about the transmigration of souls.

"Scientific Caution" Often Born of Ignorance of the Science of Probability

When a new theory knocks at the portals of established science asking admittance, it is commonly met with this question: What authorities vouch for your truth? While this is a reasonable question on the part of a layman, it is wholly unreasonable on the part of scientists who specialize in the field to which the theory relates. They should ask not who is sponsor for the truth of the theory, but what facts indorse it. As a case in point we may quote from Prof. Goldthwait's preface to Antevs' "Recession of the Last Ice Sheet in New England." Speaking of Agassiz's ice-age theory he says: "American geologists for 20 or 30 years hesitated to accept the new explanation (of drift phenomena), owing to the difficulty of conceiving a glacier so thick and so extensive that it could spread its records continuously across uplands and valleys. The unhappy effect of an inhospitable attitude toward a new theory and new methods was clearly illustrated here during the period from 1841 to 1870, when the glacial theory was on probation. Lively discussions of it, as reported in contemporary proceedings of our scientific societies, betray the human tendency to judge a theory by the number and prestige of its adherents and converts instead of by careful and impartial consideration of the evidence."

There is in such cases—and they may be said to be typical—abundant evidence of a combination of professional jealousy and ignorance of research methods that is most discouraging. Since there is little hope of changing human nature save by slow evolution, we will not discuss the professional jealousy feature of the opposition to a new theory. As to removing ignorance of research methods, there is much more hope. In fact, it is certain that this can be accomplished.

To begin with, all scientific men should be taught to read the history of science enough to see for themselves that every theory was not only imperfect at its birth, but has remained imperfect to the present day. Once this fact is fully grasped, it becomes obvious that no theory should ever be rejected because of its defects, provided only that it is in accord with a sufficient body of facts to render its fundamental truth at least possible. Scientists not well enough read to have come to this conclusion are prone to seek for a defect in any new theory, and exultantly hold it aloft as proof conclusive that the theory is false. "False in one, false in all" may be a good maxim by which to judge the reliability of a witness, but it is the poorest of guides in judging the merit of a theory.

Most of us know that an invention is invariably so defective in the early stages of its development that it looks hopeless to all but the inventor himself. Much the same is true of a new scientific theory. Everyone but its discoverer is prone to regard it as fantastic. The discoverer alone sees in it possibilities of development.

Theories always develop. A theory starts as a rather crude explanation, suggested by some analogy between a well known phenomenon that the theory aims to explain. Gradually it becomes evident that while the two phenomena are somewhat alike, they differ enough to make it necessary to modify the embryonic theory. And so, step by step, the theory is modified to bring it into closer and closer accord with the facts. Perfect accord is never attained. Until Einstein appeared on the scene, there was at least one theory, namely, Newton's theory of gravitation, that was regarded as perfect. But behold the recent change of scientific belief!

Jevons was the first scientific writer, we believe, to voice the opinion that no scientific law is perfect. In his "Principles of Science," p. 450, he says: "The further we advance in any generalization, the more numerous and intricate are the exceptional cases still demanding further treatment. The experiments of Boyle, Mariotte, Dalton, Gay-Lussac, and others, upon the physical properties of gases might seem to have exhausted that subject by showing that all gases obey the same laws as regards temperature, pressure and volume. But in reality these laws are only approximately true, and the divergencies have afforded a wide and yet quite unexhausted field for further generalization." On an earlier page (146) he said: "Seldom, indeed, shall we have a theory free from difficulties and apparent inconsistency with facts. . . . Almost every problem in science thus takes the form of a balance of probabilities."

This last sentence gives us another clue to the reluctance of scientists to endorse a new theory. Very few of them seem to know how to weigh a probability. Yet without that sort of knowledge they are incapable of passing safe judgment upon any theory that is susceptible of test by a probability calculation. Undoubtedly "scientific caution" is usually born of a timidity that springs from lack of knowledge of that branch of science known as Probability.

H. P. Gillette

New Equipment and Materials

Recent Developments in Machines, Tools and Materials in the Road and Street Field

New Telsmith Portable Crushing, Screening, Loading Plant Equipped with Gyratory Crusher

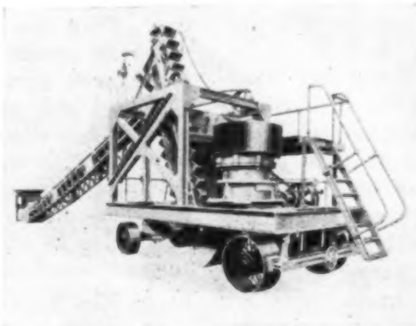
A portable crushing, screening and loading plant equipped with a gyratory crusher has been announced by the Smith Engineering Works, Milwaukee, Wis., manufacturers of rock, ore and gravel-handling machinery. Greater capacity, flexibility, finer crushing and more rugged construction are all stated to be combined in this new Telsmith rig, which is mounted on wheels and can be easily moved from place to place.

The new Telsmith portable will deliver two accurately sized products to conform exactly with state or county specifications for gravel or hard surfaced roads. The plant may be equipped with a No. 32 Telsmith reduction crusher, to deliver sand and minus ¾-in. rock or with a 6-A or 8-A Telsmith primary breaker to deliver sand and minus 1½ in. Since the crusher is in a closed circuit with the screen, there is no oversize.

For quarry operations, adding either a 10-A Telsmith primary breaker or a Telsmith jaw crusher, at the foot of the feed conveyor, converts it into a two-crusher plant with a large capacity of ¾-in. or 1-in. product. If only one final product is desired, the plant can be furnished with a single deck vibrating screen and only one finished product conveyor, the steel conveyor for coarse finished product being omitted. The second deck for the vibrator and the second finished product conveyor, can be added at any time if it is desired to change to a two-product plant.

The standard plant requires a 40 to 45-hp. electric motor. When a gasoline engine or tractor is used, power should be increased proportionately or about 50 to 60 hp. The standard plant has six units as follows:

1. Steel receiving hopper with reciprocating plate feeder.
2. Steel frame feed conveyor with 2-wheel truck.
3. Complete crushing and screening plant, mounted on heavy trucks with (a) double-deck vibrating screen, (b) gyratory crusher, (c) elevator to return crushed product to screen, (d) jib crane, (e) steel operator's platform.
4. Steel conveyor for fine finished product.
5. Steel conveyor for coarse finished product.
6. Two-compartment, all-steel storage bin for loading trucks.



Portable Crushing, Screening and Loading Plant Equipped with Gyratory Crusher

The Telsmith portable plant is claimed to have a surprisingly large capacity: In clean sand and gravel when making two products with sand separate from gravel, 30 to 40 tons per hour, depending upon final size of gravel wanted and percentage of sand in deposit; in clean sand and gravel, when sand is mixed with gravel, making only one final product, 40 to 60 tons per hour, depending upon final size wanted; in crushed stone, 20 to 25 tons per hour, depending upon size of finished product wanted.

The plant is all steel and equipped with anti-friction bearings throughout. All conveyors equipped with three pulley troughing idlers with anti-friction bearings. The total weight of the plant is 53,800 lb. As usual, this new Telsmith product is backed by Telsmith's guarantee.

"Schramm" Tractor Driven Compressor Attached to Model "20" Cletrac

This is a self-propelled unit that can be driven under its own power—over paved streets, or the roughest surfaces.

The compressor is shipped ready to attach to the Cletrac, no changes of any kind being necessary. Simply install power take-off shaft on tractor together with double Universal joint and long spline shaft coupling, and bolt Universal draw bar coupling to the cross piece of the draw bar. This can be done by any unskilled mechanic and results in a flexible hook-up that lends itself to any bumpy roads, turns, etc.

One of the advantages of a combination of this type is the fact that the compressor can easily be uncoupled and the tractor used for many other purposes. On hauling especially, the full power of the tractor is available. Another point is the fact that the power take-off of the tractor is also available for operating other power units.

The tractor can be started separately from the compressor by means of a throw-out clutch on the power take-off of the tractor. This makes starting easier and quicker and keeps the compressor idle when driving from one job to another.

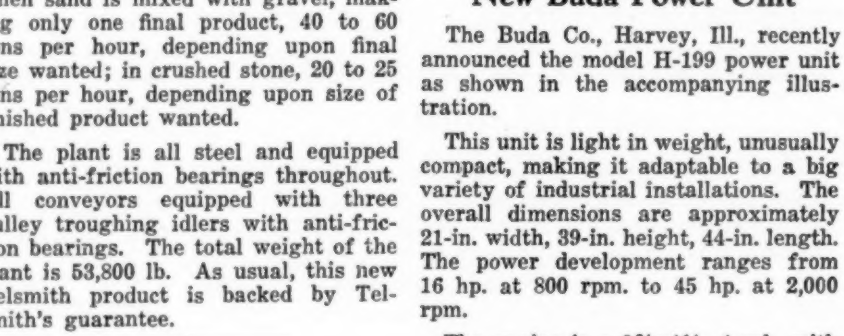
New Buda Power Unit

The Buda Co., Harvey, Ill., recently announced the model H-199 power unit as shown in the accompanying illustration.

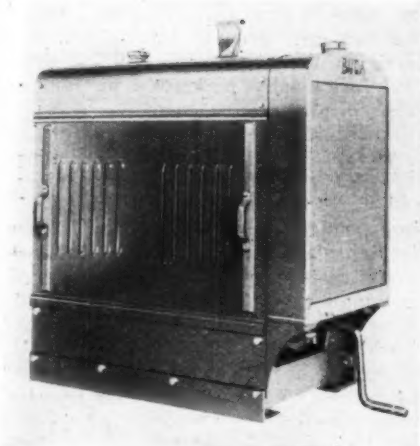
This unit is light in weight, unusually compact, making it adaptable to a big variety of industrial installations. The overall dimensions are approximately 21-in. width, 39-in. height, 44-in. length. The power development ranges from 16 hp. at 800 rpm. to 45 hp. at 2,000 rpm.

The engine is a 3¾x4½, 4-cyl., with a piston displacement of 199 cu. in. The crank shaft is 3-in. diameter on five main bearings and the shaft is unusually short and close coupled.

The lubricating feature of this engine is the constant supply of a large quantity of oil at high velocity and uniform pressure. The cooling system is also very effective, as there is no excess water jacketing about the cylinder bores, which insures the engine arriving at proper operating temperatures very rapidly. A large capacity



Compressor-Tractor Combination



New Buda Power Unit

water pump passes a large volume of water at high velocity through the engine at all times. The water pump is equipped with stainless steel shaft and leak-proof bearing.

The main bearings are the customary half shell, babbitt-lined type, but are shimless. Two halves of a bearing placed edge to edge effect a perfect circle. In boring the engine housing to receive these bearings manufacturing limits as close as five ten-thousandths of an inch are necessary for accuracy. The same is true of the crank grinding. The thickness of the bearings themselves cannot vary over the same amount. In fact, the upper halves of the main bearings can be removed without taking down the crank shaft by simply forcing one-half out by forcing another half in its place.

The connecting rods are babbitt-lined directly to the steel forgings. This makes a light and cool bearing, giving a perfect bond between the bearing and the steel forging. The length of the rod between bearings or between centers is unusually long.

The valve tappet cluster assembly is worthy of special mention, as it is made in two groups and designed for quick accessibility in service. The crankcase and cylinders are of chrome nickel alloy iron, the longest wearing iron known today. Provision is made for the use of fuel pump, oil filter and electric starting equipment when desired. The air cleaner is built in as a part of the engine.

A large capacity radiator is furnished which cools the engine under the most adverse conditions. The radiator is supported on a casting which also carries the front end of the engine. The fan is of 18-in. diameter with 4 blades and is driven from the crankshaft by a "V" belt.

The engine has a pedestal bell housing making it possible to support the unit rigidly either with or without the channel frame. Sheet metal housing is of heavy gauge material with sliding doors providing ample accessibility. A gasoline tank is provided in the hood of the unit, which permits gravity flow of fuel to the carburetor. The tank is of 12-gal. capacity.

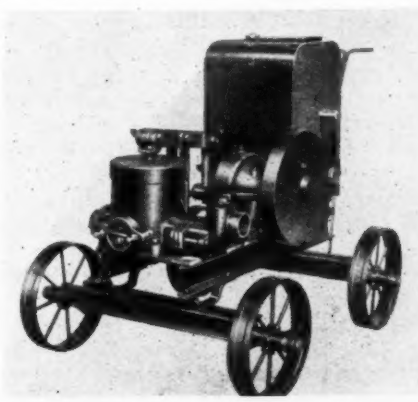
The engine is fitted with a No. 4 S. A. E. bell housing which accommodates an 8-in. clutch. The unit can also be furnished with reduction gear, reversing gear and transmission.

A close regulating governor is supplied. It is completely enclosed and operated directly on the butterfly valve, on the carburetor.

New Plunger Pump

The Novo Engine Co., Lansing, Mich., has designed, tested and put on the market a pump that is stated to be entirely new in principle, design and performance.

This pump is known as the roller ring plunger pump. One of the main features of this pump is that it does away with changing diaphragms, packing the pistons, etc., for it has no diaphragms, no packing or oil seal. An absolutely liquid tight water seal is maintained by two rubber rings on the plunger that roll with the action of piston as they are pressed against the cylinder wall. The rolling action of



Novo Roller Ring Pump Powered with Novo KU 3 Hp. Single Cylinder Roller Engine

these rings prevents friction and hence lack of wear permitting the use of one set of rings for a season's work without a change.

Due to the rapidity of the strokes of the plunger, which operates at 120 strokes per minute, water is forced through the pump at a very high velocity, permitting it to carry along with it a great deal of foreign material held in suspension. This is also facilitated by the fact that it is a straight line flow from the suction inlet to the discharge. Also the rapidity of the strokes create a more constant and uniform flow of water, for there is no lull between strokes as is the case of a slower acting pump.

The pump is compact and light, weighing only 960 lb. It has a capacity of 3,500 to 5,000 gal. per hour and develops a 100-ft. head. For high speed hauling it may be mounted on a coil spring rubber tire trailer, as shown in illustration, Fig 1503. The illustration shows the standard mounting—a 4-wheel truck.

Portable Air Hoist

Ingersoll-Rand Co., 11 Broadway, New York City, has introduced a new-sized "Utility" portable air hoist of 2,000-lb. capacity.

"Utility" hoists, in capacities up to 1,500 lb., have been used by miners and contractors for the past three years. The addition of the 2,000-lb. size makes this type of hoist available for additional classes of work.

The fact that the hoists are of comparatively light weight permits them to be readily moved about wherever there is work to be done. The hoists can be bolted to a timber or mounted on a post or steel column in any convenient location.

The "Utility" employs a radial, four-cylinder, counterbalanced, reciprocating-piston-type air motor, which is reversible. All wearing parts and cylinders are easily renewable, and the cylinders are also interchangeable.

The reduction gears between the motor and drum are all machine-generated spur gears cut from carefully selected material, and, wherever necessary, they are heat-treated to insure ample strength and wearing qualities. The gears are completely enclosed in a housing, which excludes all dust and permits the gears to operate in a bath of semi-fluid grease.

Ball and roller bearings are used at all points where they will add to the efficiency and life of the hoist.

The bronze throttle valve is tapered and is fitted ino a bronze bushing. Its ease of operation, sensitive graduation, adjustment for taking up wear, and extremely simple design are outstanding features.

A clutch of the positive-jaw type is used to disengage the motor. This clutch is thrown out by an eccentric shaft controlled by the clutch lever. This lever is conveniently located on the top of the hoist and automatically locks to hold the clutch either engaged or disengaged.

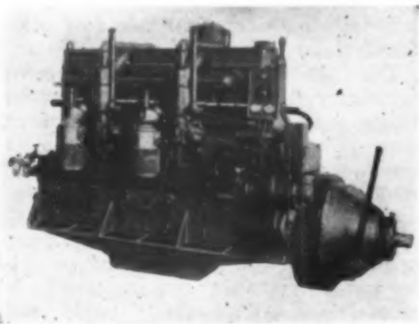
A brake of the bank type wraps the drum at its largest diameter. The operating lever for the brake is conveniently placed and may be adjusted to any one of six operating positions.

The motor is completely enclosed in a dust and dirt-proof case.

Size EU "Utility" Hoist

Blue Streak Engines Can Now Use Distillate or Gas-Oil as a Fuel

The Climax Engineering Co. of Chicago, Ill., and Clinton, Ia., announces that its line of Blue Streak engines is



Climax Blue Streak Engine Equipped for Oil Burning

now provided with equipment making possible the using of fuel of 36° to 40° Baume, and costing about half that of gasoline. Mean effective pressures of 90 lb. per square inch with power, flexibility and fuel consumption are secured comparing very favorably with those obtained from good gasoline burning industrial engines of conventional design. Equipment is the same as that employed on the gasoline burning engine, with the addition of an oil rectifier, a heat control mechanism and a water supply for full load operation.

The oil rectifier reduces dilution of the lubricating oil, maintaining it at a satisfactory minimum for successful operation, and with this device especially developed for this service dilution will not exceed standard gasoline operation. To provide the flexibility necessary for the successful handling of the different loads and speeds encountered in the various industrial applications, the heat supplied to the fuel mixture is varied automatically with the load. The mechanism controlling this important function is very rugged and simple in construction, and consists essentially of an aluminum body attached to the carburetor air horn, containing a sylphon bellows, an air valve, water valve, and air cleaner. Hot air is supplied to this mechanism through a flexible conduit connected to an air box built around the exhaust manifold.

Unheated air is admitted to the mechanism body through the Air Maze Cleaner shown in the illustration. Air Maze Cleaners are also attached to the openings on the hot air box, fully protecting the induction and manifold system from dirt and other foreign particles.

The syphon is connected to the intake manifold by a copper tubing so that pressure changes caused by various loads imposed on the engine are transmitted to the syphon, thus providing a motive power to operate a valve controlling the supply of heated or unheated air. This part is similar to the spark control mechanism used on Climax engines during the past two years, and is, therefore, a device which has been subjected to considerable field service and experience.

On demands for power exceeding three-quarter load, the movement of the sylphon opens a valve controlling the supply of water to the fuel mixture. The valve body may be seen mounted on the elbow connecting the hot air conduit with the main body proper. The water supply is furnished by a conventional diaphragm fuel pump mounted upon and driven by the engine.

In starting, gasoline is used until the engine is warmed up and then the gasoline supply is cut off and fuel oil admitted; no other operation being required. On single carburetor engines one heat control device is used; in the illustration shown bearing two carburetors, dual equipment is provided, so that one design may be universally employed.

New Trackson Crawler Wheels

A recent product of the Trackson Co., Milwaukee, Wis., designed for installation on wagons and trailers to meet the heavy hauling requirements of every industry. The crawler wheels

Trackson Crawler Wheels

are built of heavy alloy steel castings and drop forgings—and every part is generously proportioned to provide a wide margin of safety over the rated load capacities of the wheels.

The tension members or links which hold the shoes in rigid rail position are made of extra-heavy drop forgings, especially heat-treated. These links function simply by moving to and fro within one another, without any turning or grinding action. Small parts such as bolts or toggle-links are entirely eliminated in these wheels.

Another distinctive feature claimed for the Trackson crawler wheels is the take-up device which provides for tightening the track shoe loop by varying the wheel centers to suit different operating conditions. Since the shoe loops should be neither too tight nor too loose for most efficient operation, this take-up device is important. Also, it is especially effective because of its simplicity and accessibility.

Split-type hardened steel bushings are used in the shoe hinges. These bushings are pressed into place and keyed in the lug to prevent turning. They are easily reversible or removable, however, when worn.

Trackson Crawler Wheels may be installed on almost all makes of wagons. They are manufactured in four sizes, with 6, 10, 15 and 20-ton load capacities, respectively. The 10 and 15-ton size wheels will be of special interest to contractors, since they can be used on wagons with from 5 to 10-yd. capacities.

Additional information may be obtained by writing the Trackson Co., Milwaukee, Wis., for their new crawler wheel circular.

New 3-Way Dump Wagon

A new 3-way dump wagon, with a capacity of 7 to 8 tons, has been brought out by LaPlant-Choate Manufacturing Co., Cedar Rapids, Ia. The body dumps either to the rear, to the right or to the left. It is hydraulically operated, with downfolding doors which open and close automatically as the body is raised and lowered. The entire dumping operation is controlled by the tractor operator from his seat on the tractor.

The body on the LaPlant-Choate 3-way dump wagon is built by the Differential Steel Car Co., of Findlay, O., who have been making dump bodies for trucks and railway cars for a number of years. Their experience and success in building bodies have been combined in the construction of this new body which is mounted on LaPlant-Choate chassis and "Roadlayer" tracks.

The body, frame, and tracks are built entirely of steel, made to withstand the roughest treatment and hardest usage.

The body is made of ¼-in. steel, and the floor plate is flanged on each side 8 in. To this flange is attached longitudinal and cross members on which the hinge castings and also the lifting jack rest, thereby getting a solid ribbed steel backbone for the body.

The sides and bottom are ¼-in. plates, and the bottom is so constructed that there is a cushion of 2-in. seasoned wood placed on top of the lower plate, which is covered with another renewable ¼-in. plate. This absorbs any jar resulting from the dropping of large heavy rocks or other objects on the wagon floor. This construction is part of the standard equipment, and no extra charge is made for this feature.

LaPlant-Choate 3-Way Dump Wagon

DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group

1930 EXECUTIVE BOARD OF THE ASSOCIATED EQUIPMENT DISTRIBUTORS.

Top row, left to right: A. C. Blaisdell, Secretary A. E. D., secretary of Queen City Supply Co., Cincinnati, Ohio; Dan R. Brown, Director, A. E. D., president Brown-Bevis Co., San Francisco; Mark Kaplan, Director, A. E. D., sales manager Superior Supply Company, Chicago; H. W. Fletcher, Treasurer, A. E. D., also treasurer and general manager Clyde Company, New Orleans, La.
Center Row: Oscar B. Bjorge, Second Vice-President, A. E. D., manager Clyde Equipment Company, Portland, Oregon; A. A. Fuchs, President A. E. D., vice-president Fuchs Equipment Company, Omaha, Nebraska; N. Floyd, Jr., First Vice-President A. E. D., treasurer Hubbard-Floyd Company, Inc., New York.

Bottom Row: Carl Borchert, Director, A. E. D., President Borchert-Ingersoll, Inc., St. Paul, Minn.; E. K. Hurst, Director, A. E. D., president and general manager Western Material Company, Sioux Falls, S. D.; M. R. Hunter, Director, A. E. D., president Hunter Machinery Companies, Detroit and Grand Rapids, Michigan, and Milwaukee, Wis.; T. W. Rosholt, Director, A. E. D., president T. W. Rosholt Company, Minneapolis, Minn.; Victor L. Phillips, Director, A. E. D., president Victor L. Phillips Company, Kansas City, Mo. (picture not shown).

Independent Pneumatic Tool Company Expands

Announcement has been made of the purchase of the Cochise Rock Drill Company of Los Angeles by the Independent Pneumatic Tool Company of Chicago, manufacturers of Thor electric and pneumatic tools and air compressors.

The plant of the Cochise Company will be expanded, additional workmen will be employed and the products manufactured will be incorporated in the present line of the Independent, according to announcement. It is stated that the Cochise Rock Drill Manufacturing Company will operate as a unit of the Independent Pneumatic Tool Co., and there will be no change in personnel or methods.

The Independent Pneumatic Tool Company was established twenty-five years ago and last year a new and modern plant addition was built and today the factory covers an entire city block in Aurora, Ill.

New Birmingham Distributor for Trackson Co.

Millsap Road Machinery Company, located at 23rd St. and 23rd Ave., Birmingham, Ala., is to have charge of the Birmingham territory for products of the Trackson Company, according to announcement.

The distributors will handle the complete Trackson line, including crawlers, shovels, loaders, etc., and assurance is given of prompt service on new machines and also for repair and replacement parts.